FIG.1

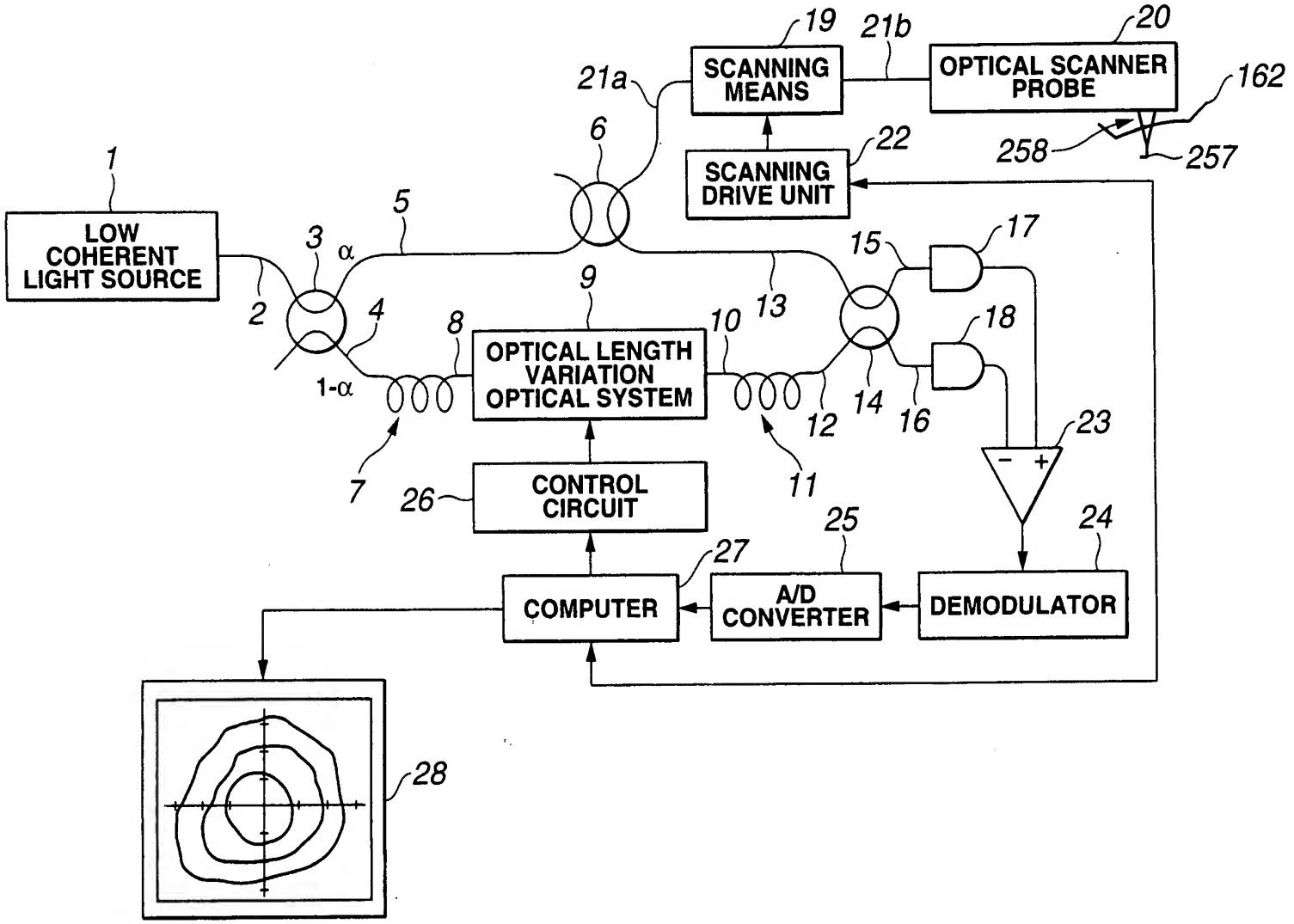
LOW COHERENT LIGHT SOURCE
SCANNING MEANS
OPTICAL SCANNER PROBE
SCANNING DRIVE UNIT
OPTICAL LENGTH VARIATION OPTICAL SYSTEM
CONTROL CIRCUIT
COMPUTER
A/D CONVERTER
DEMODULATOR
1
2
3
α
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21a
21b
22
23
24
25
26
27
28
162
258
257
1-α

FIG.2

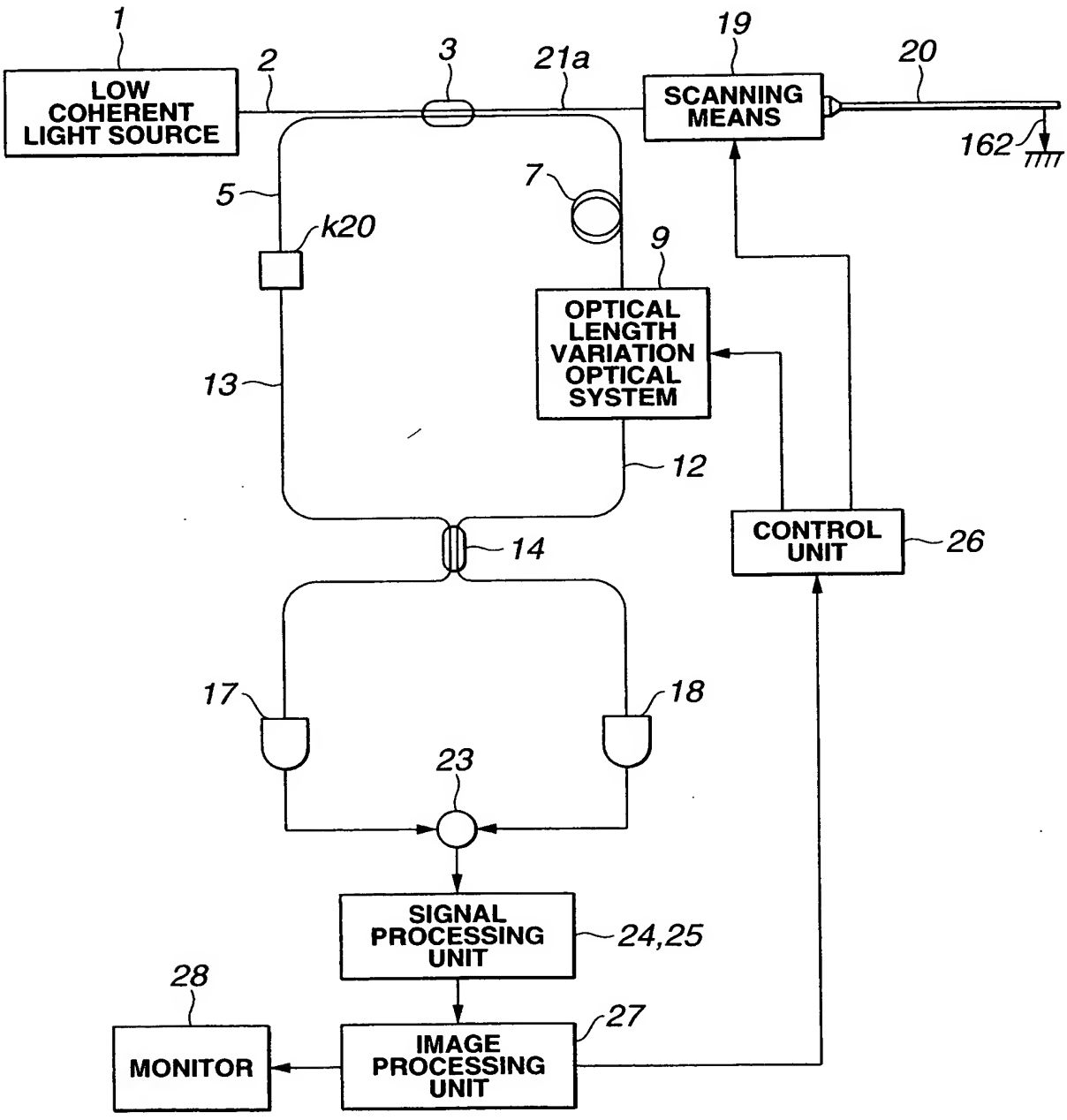
1
LOW COHERENT LIGHT SOURCE
2
3
21a
19
SCANNING MEANS
20
162
5
7
k20
9
OPTICAL LENGTH VARIATION OPTICAL SYSTEM
13
12
14
CONTROL UNIT
26
17
18
23
SIGNAL PROCESSING UNIT
24,25
28
MONITOR
IMAGE PROCESSING UNIT
27

FIG.3

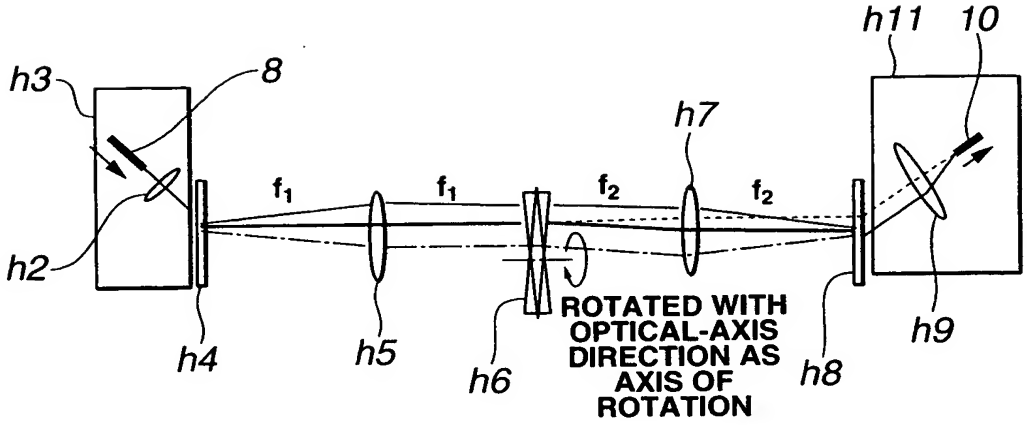

FIG.4A

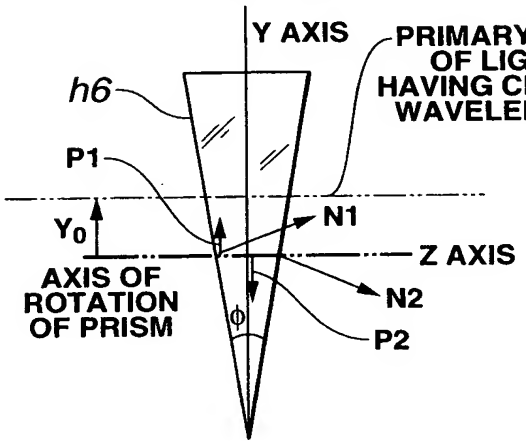

FIG.4B

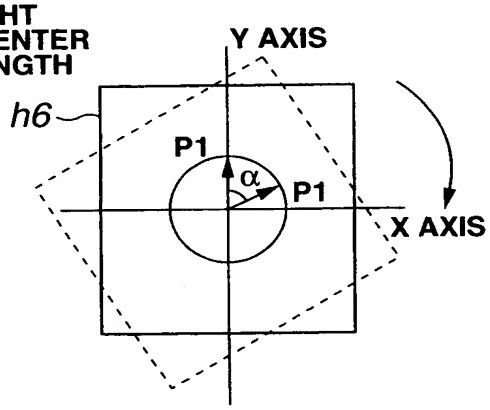

FIG.4C

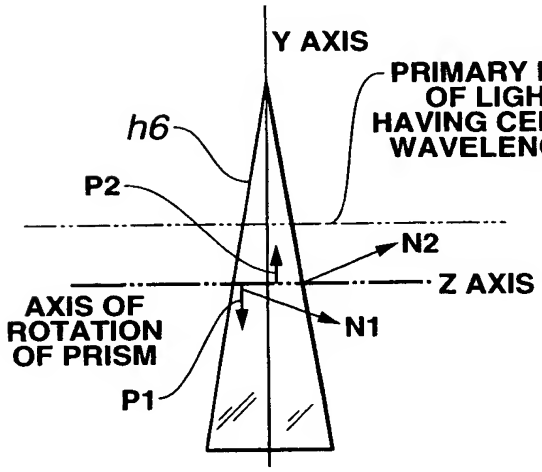

FIG.4D

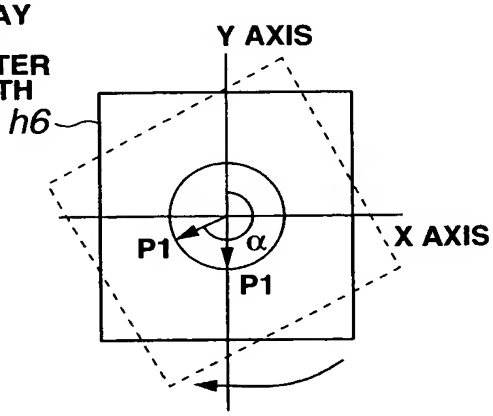

FIG.5

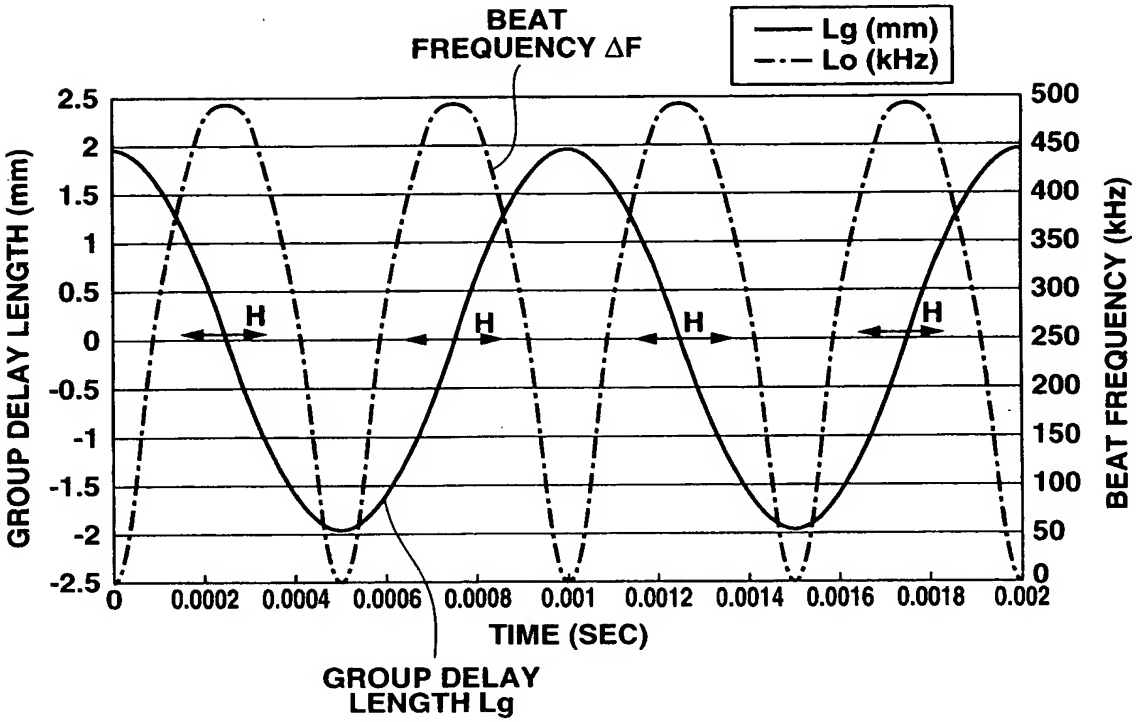

FIG.6

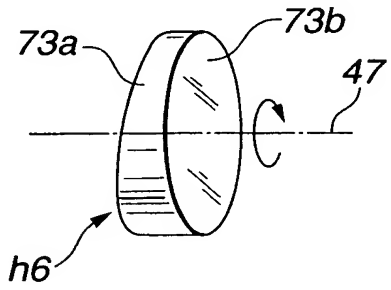

FIG.7

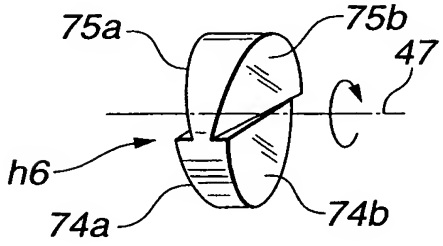

FIG.8

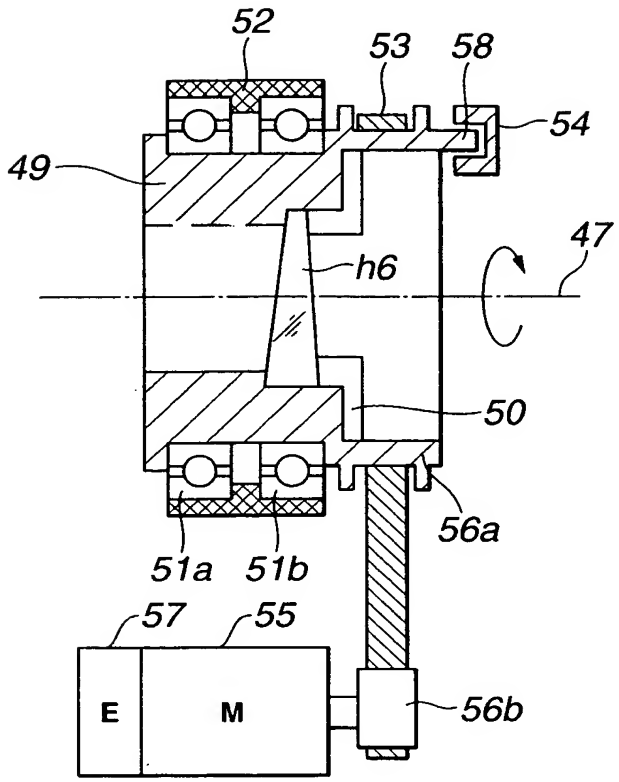
52
53
58
54
49
47
h6
50
56a
51a
51b
57
55
E
M
56b

FIG.9

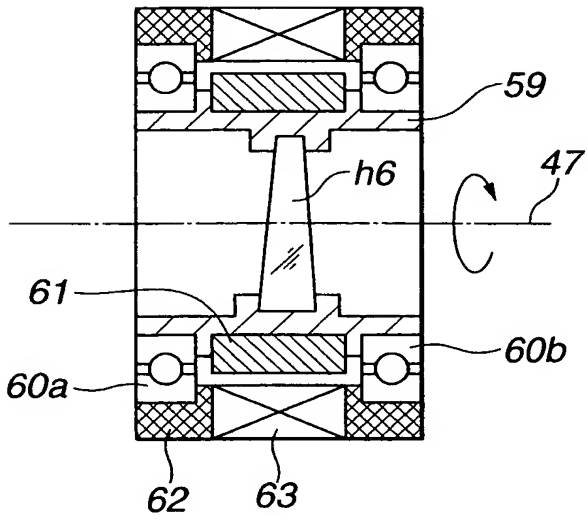
59
47
h6
61
60b
60a
62
63

FIG.10

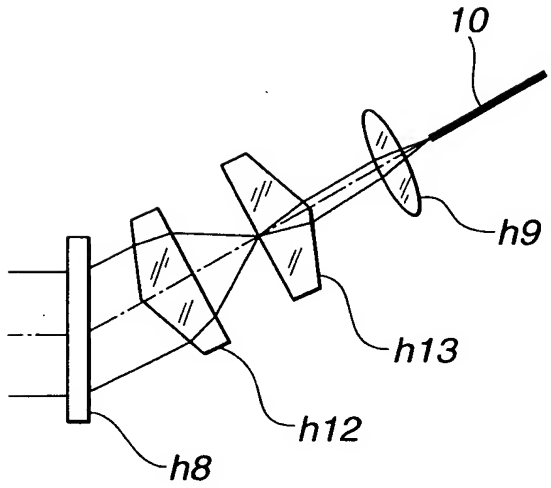

FIG.11

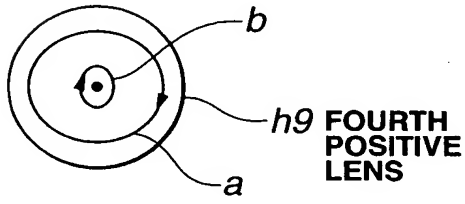

FIG.12A

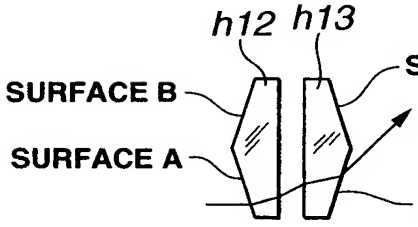

FIG.12B

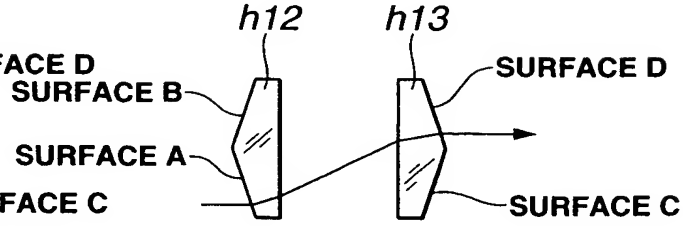

FIG.13

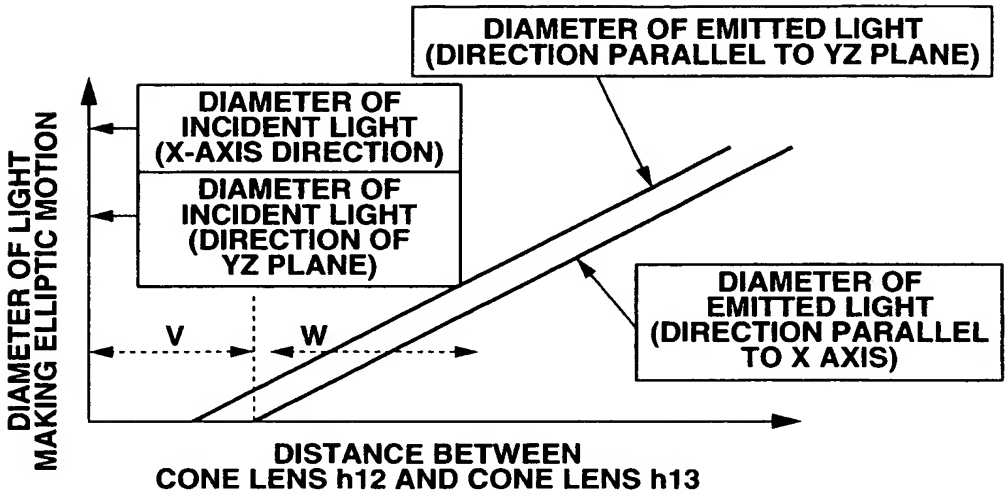

FIG.14

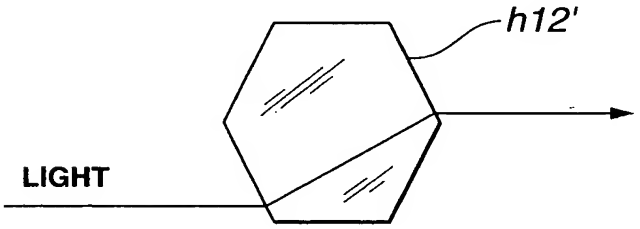

FIG.15

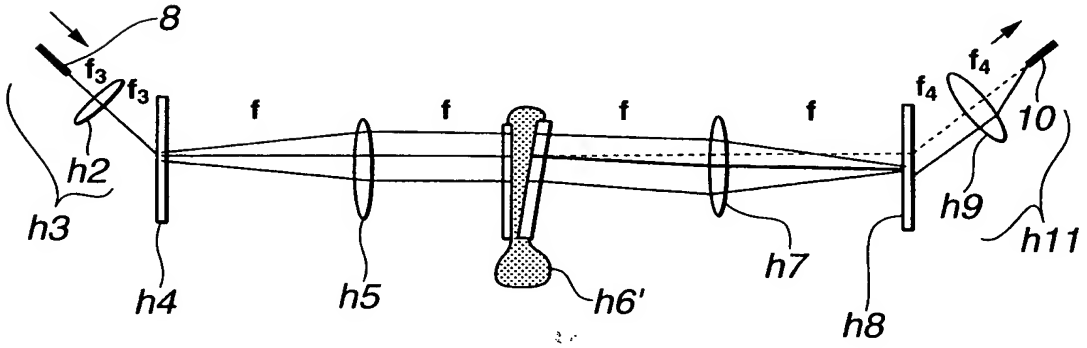

FIG.16

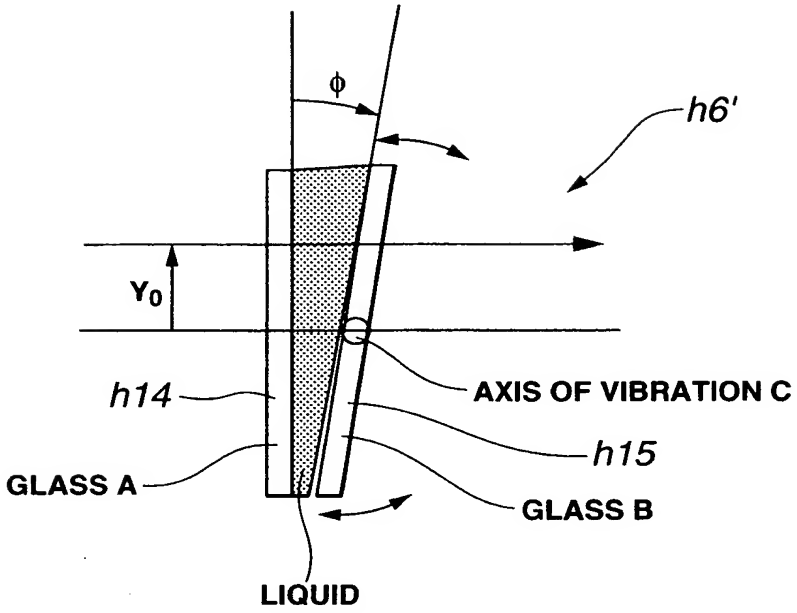
ϕ
h6'
Y_0
h14
AXIS OF VIBRATION C
h15
GLASS A
GLASS B
LIQUID

FIG.17

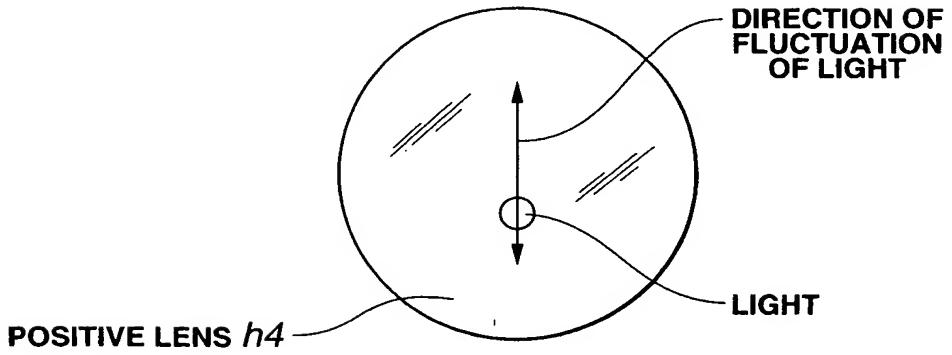
DIRECTION OF FLUCTUATION OF LIGHT
LIGHT
POSITIVE LENS h4

FIG.18A

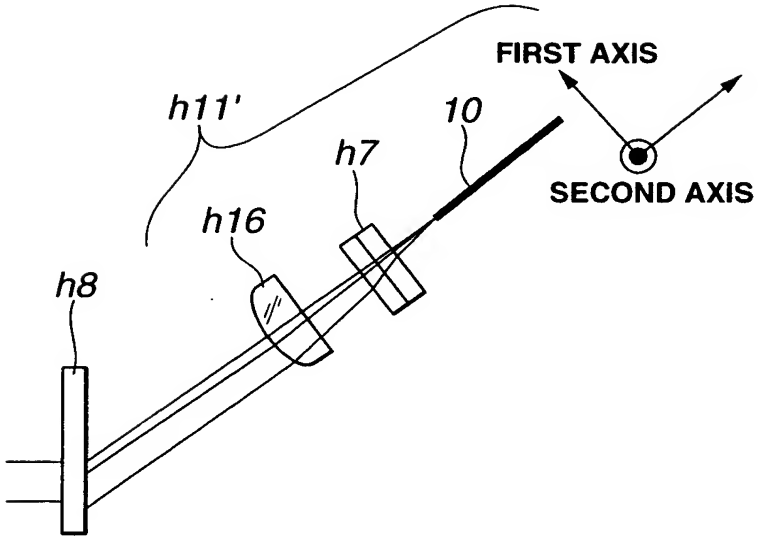

FIG.18B

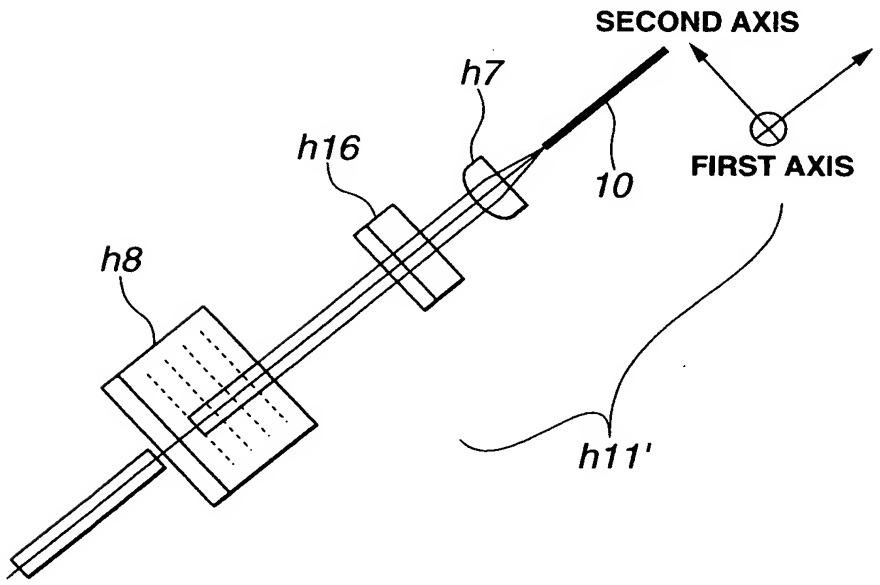

FIG.19A

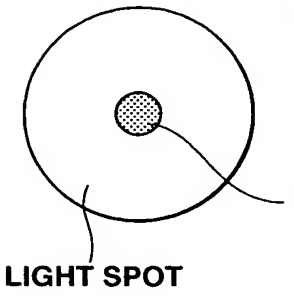

FIG.19B

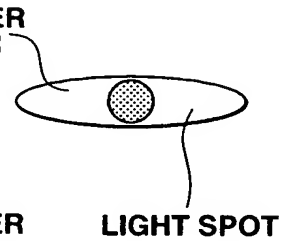

FIG.20

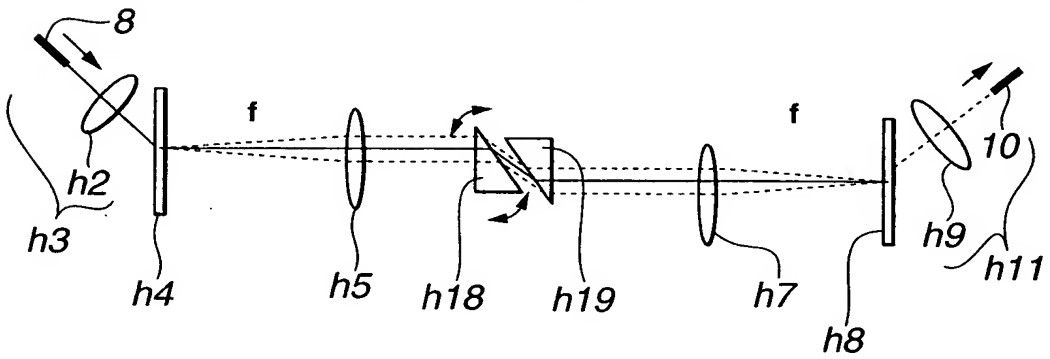

FIG.21

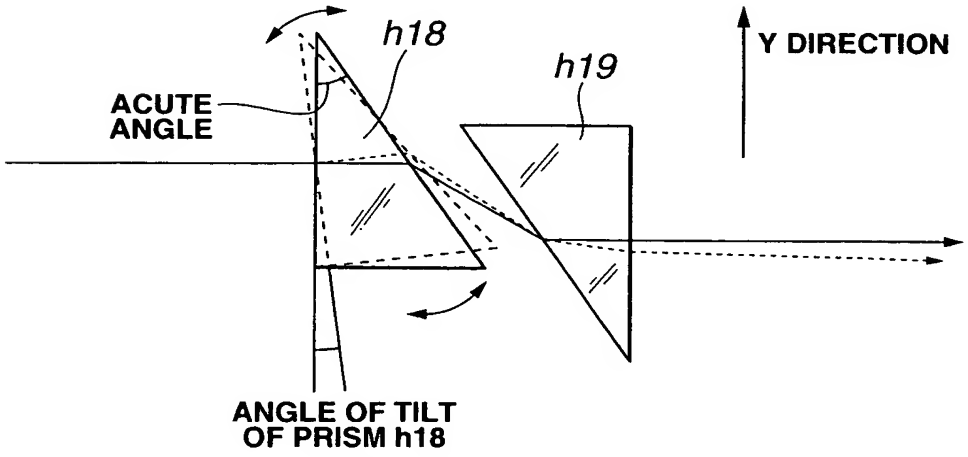

FIG.22

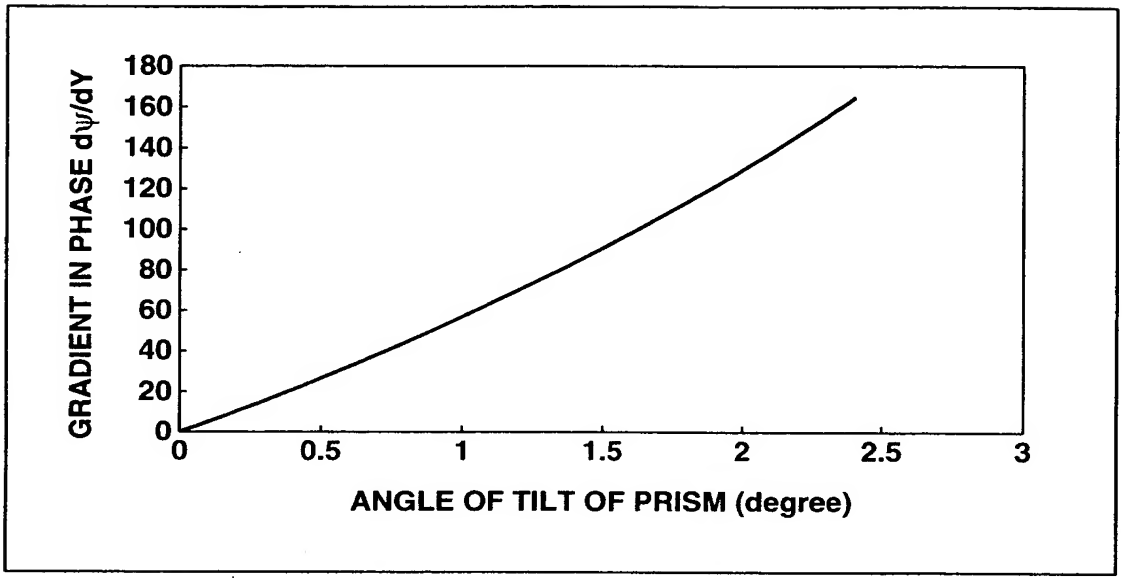
GRADIENT IN PHASE dψ/dY
180
160
140
120
100
80
60
40
20
0
0
0.5
1
1.5
2
2.5
3
ANGLE OF TILT OF PRISM (degree)

FIG.23

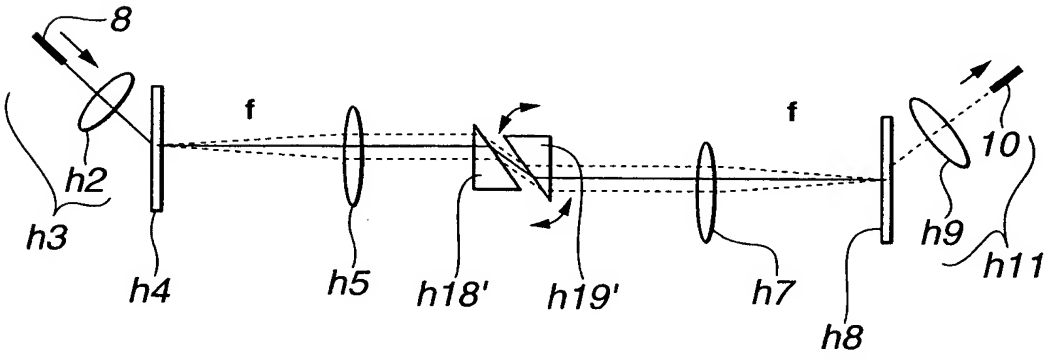
8
f
f
10
h2
h3
h4
h5
h18'
h19'
h7
h8
h9
h11

FIG.24

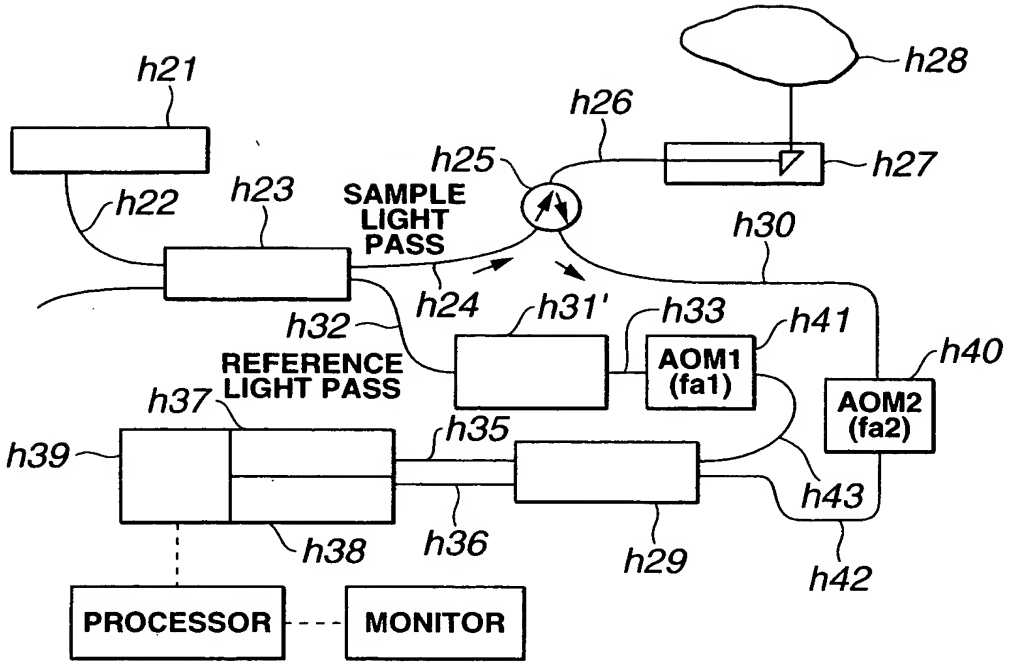
h21
h28
h26
h25
h27
h22
h23
SAMPLE LIGHT PASS
h30
h24
h31'
h33
h41
h32
AOM1 (fa1)
h40
REFERENCE LIGHT PASS
AOM2 (fa2)
h37
h35
h39
h43
h38
h36
h29
h42
PROCESSOR
MONITOR

FIG.25

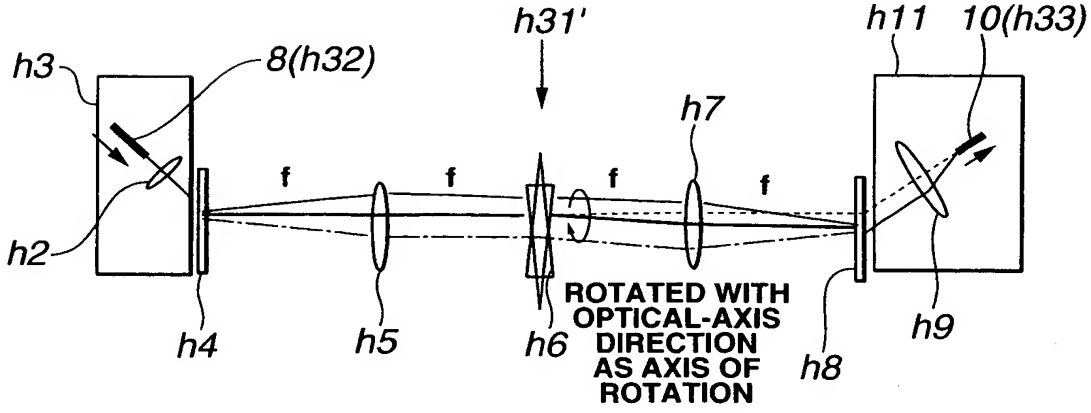
h31'
h11
10(h33)
h3
8(h32)
h7
f
f
f
f
h2
ROTATED WITH OPTICAL-AXIS DIRECTION AS AXIS OF ROTATION
h4
h5
h6
h8
h9

FIG.26

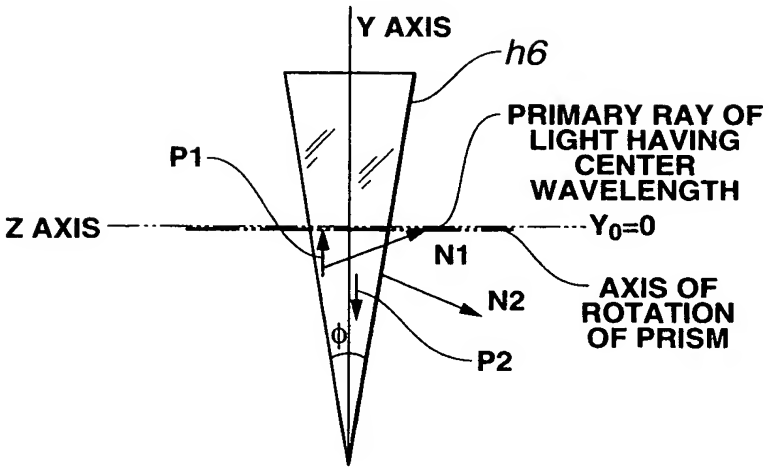
Y AXIS
h6
PRIMARY RAY OF LIGHT HAVING CENTER WAVELENGTH
P1
Z AXIS
Y_0=0
N1
N2
AXIS OF ROTATION OF PRISM
Φ
P2

FIG.27

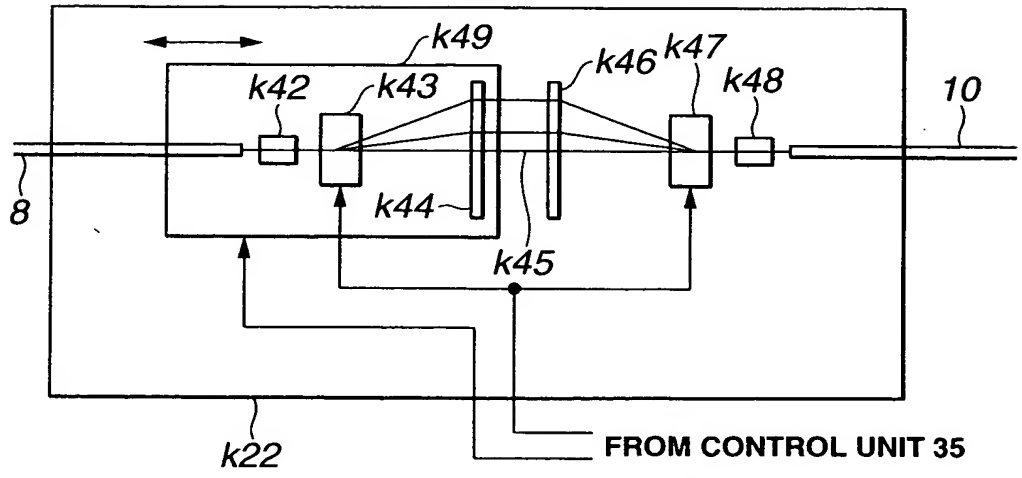
k49
k46
k47
k42
k43
k48
10
8
k44
k45
k22
FROM CONTROL UNIT 35

FIG.28

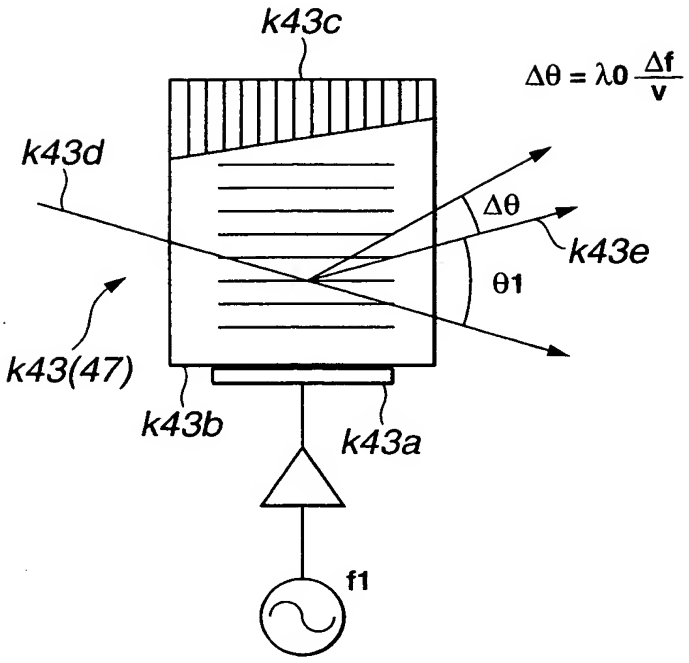
k43c
$\Delta\theta = \lambda 0 \frac{\Delta f}{v}$
k43d
Δθ
k43e
θ1
k43(47)
k43b
k43a
f1

FIG.29

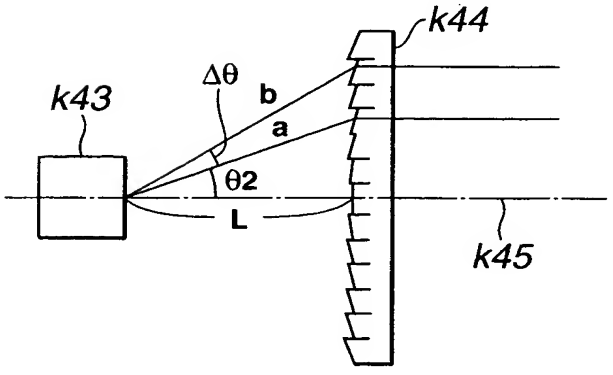
k44
k43
Δθ
b
a
θ2
L
k45

FIG.30A

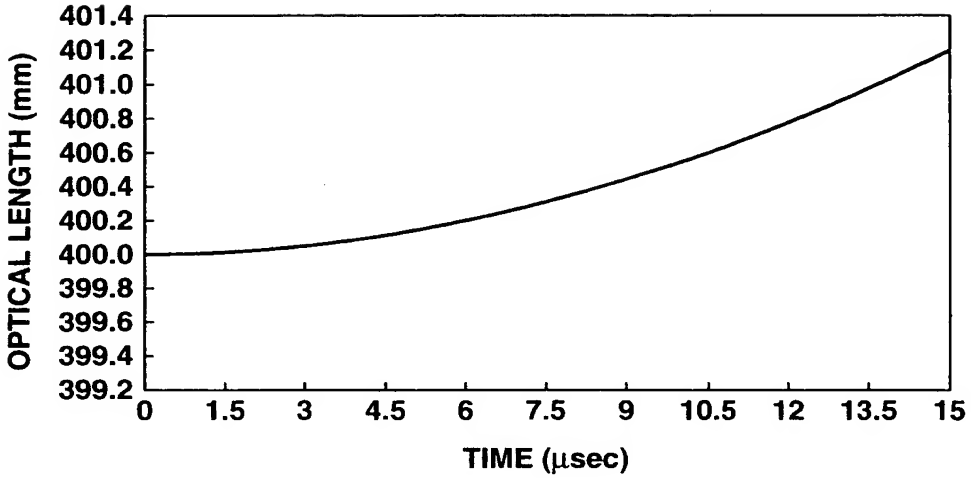

FIG.30B

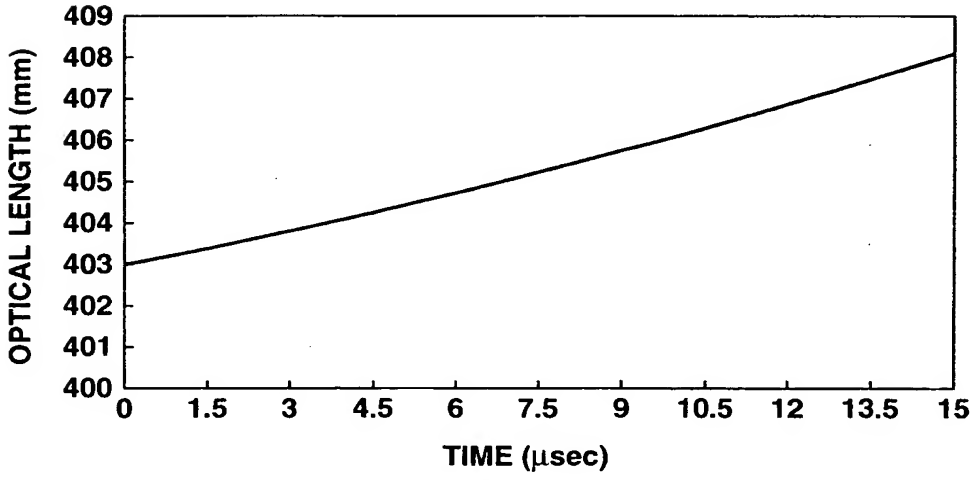

FIG.31

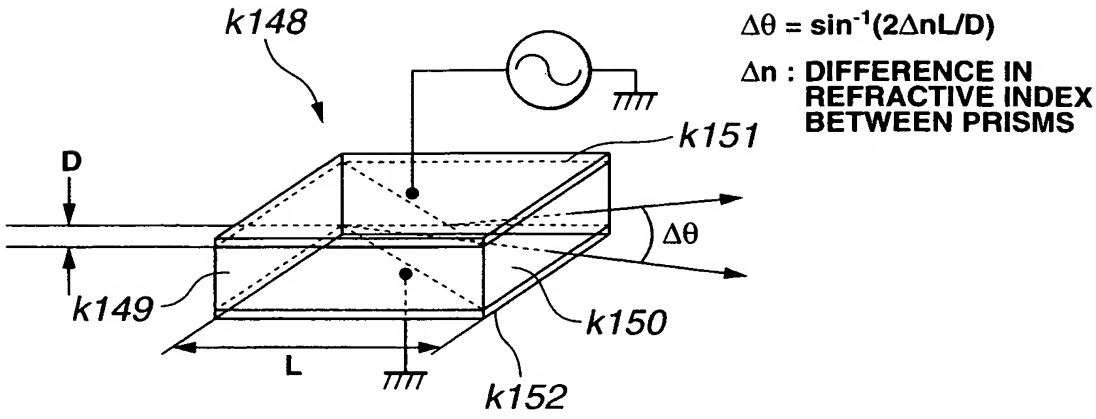

FIG.32A

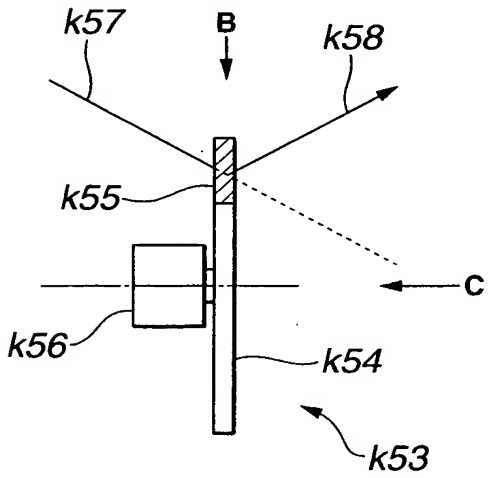

FIG.32B

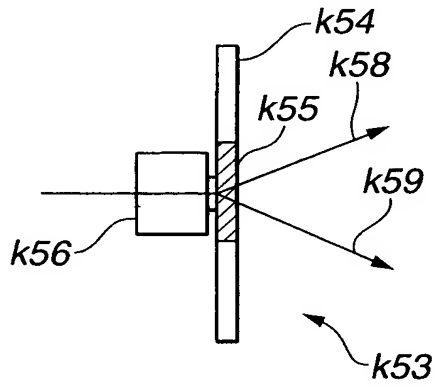

FIG.32C

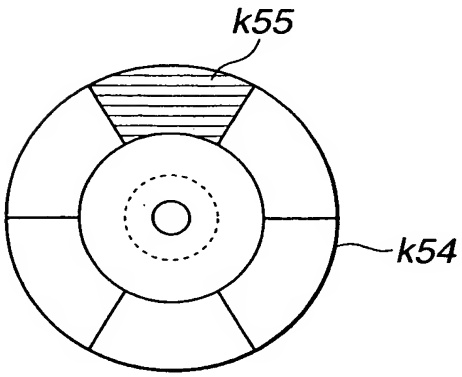

FIG.33

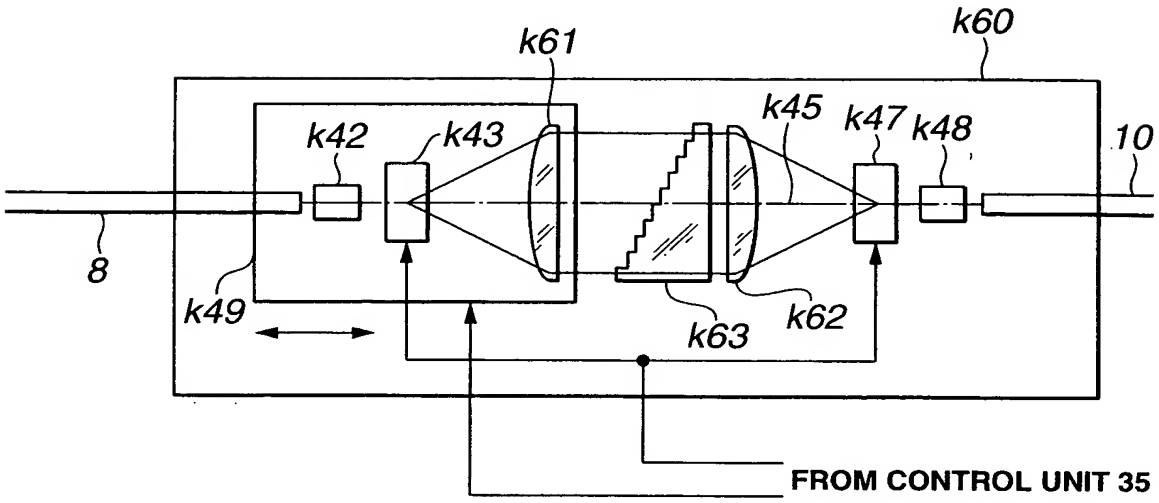
k61
k60
k45
k47
k48
k42
k43
10
8
k49
k63
k62
FROM CONTROL UNIT 35

FIG.34

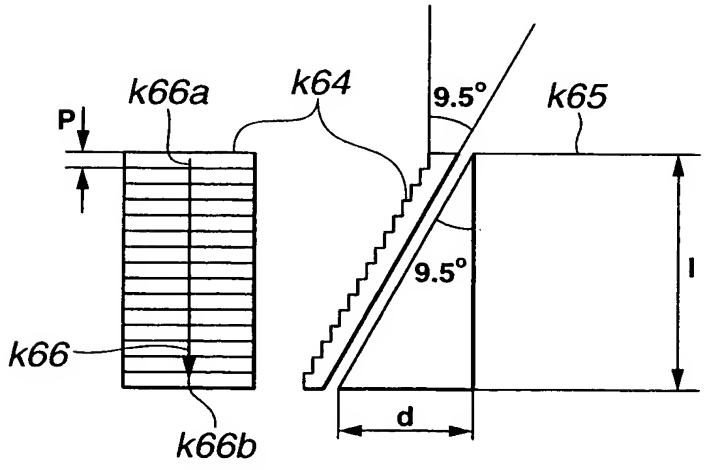
k66a
k64
9.5°
k65
P
9.5°
l
k66
d
k66b

FIG.35A

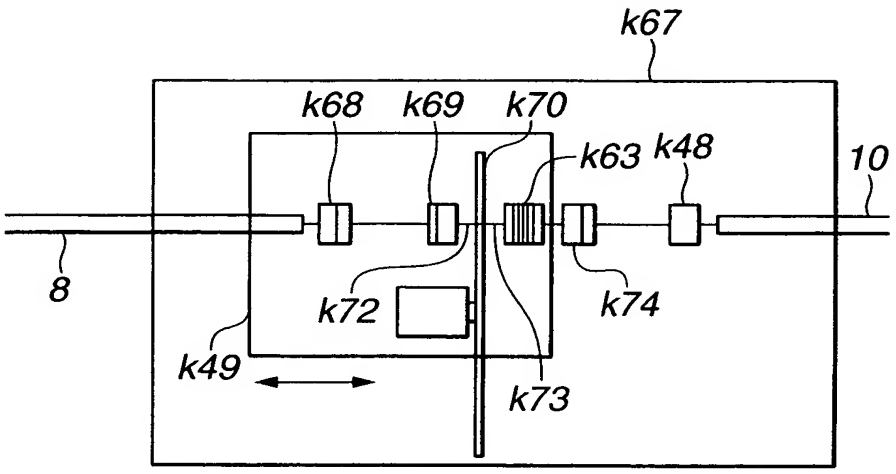

FIG.35B

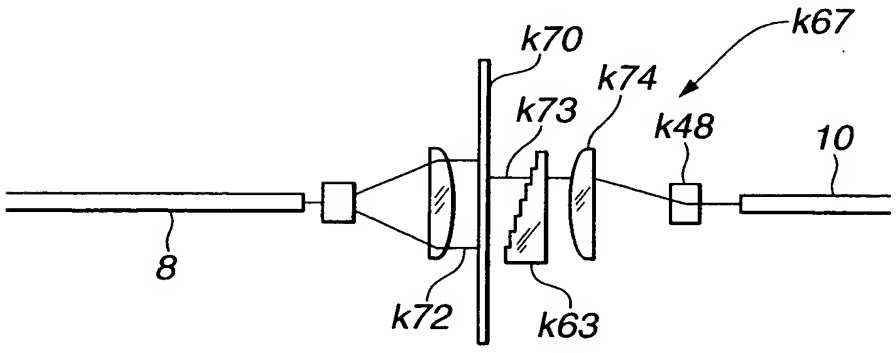

FIG.36

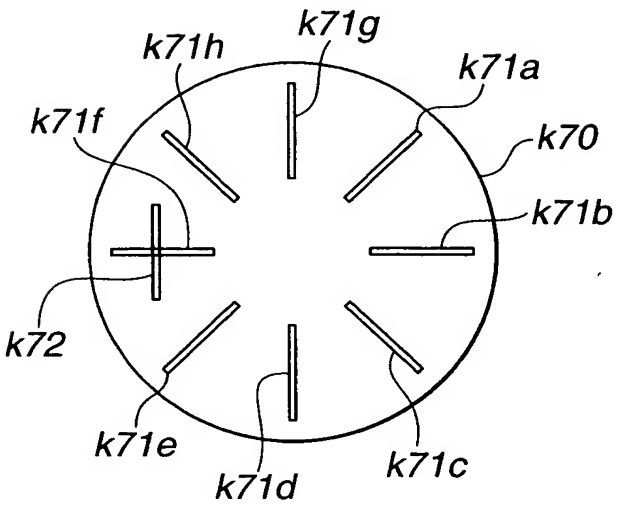

FIG.37

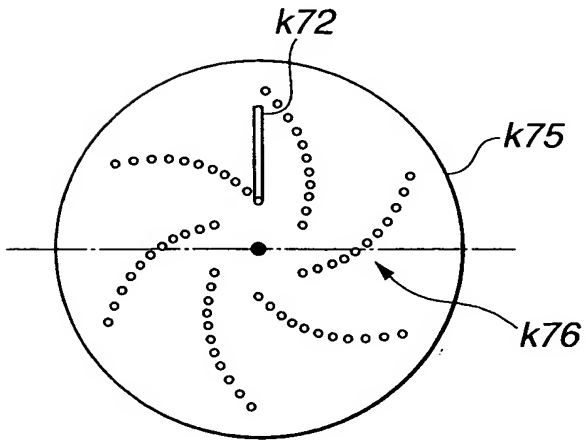

FIG.38

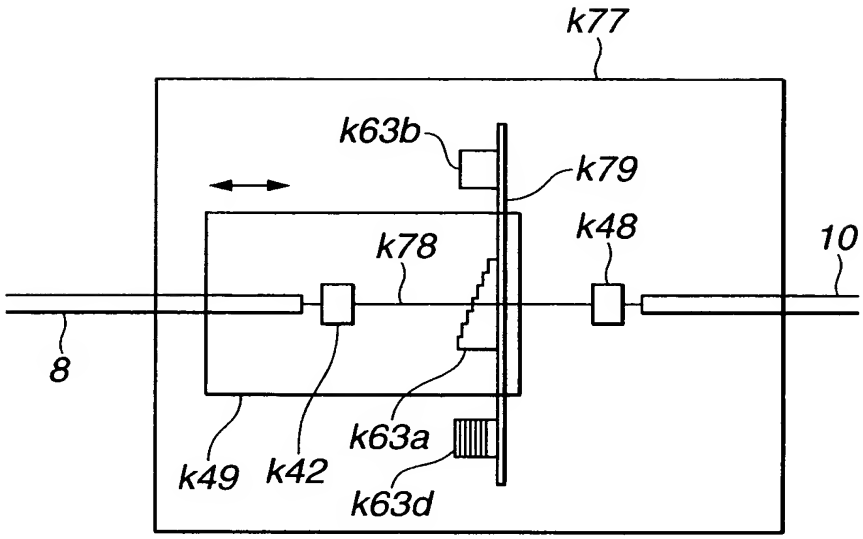
k77
k63b
k79
k48
10
k78
8
k49
k42
k63a
k63d

FIG.39

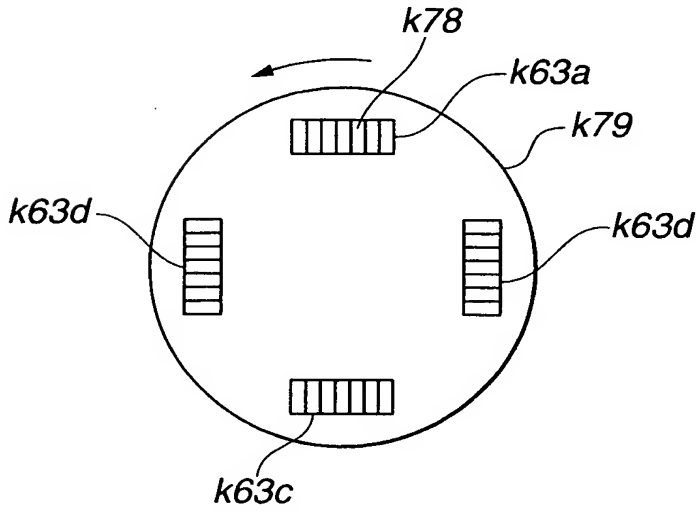
k78
k63a
k79
k63d
k63d
k63c

FIG.40

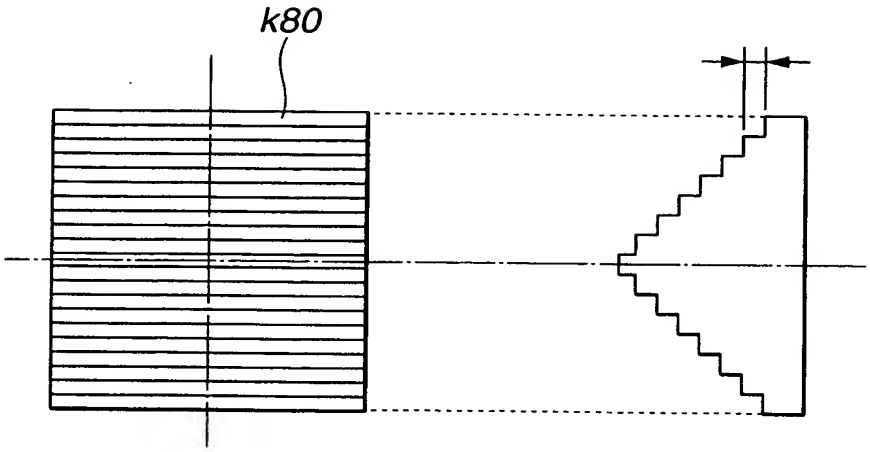

FIG.41

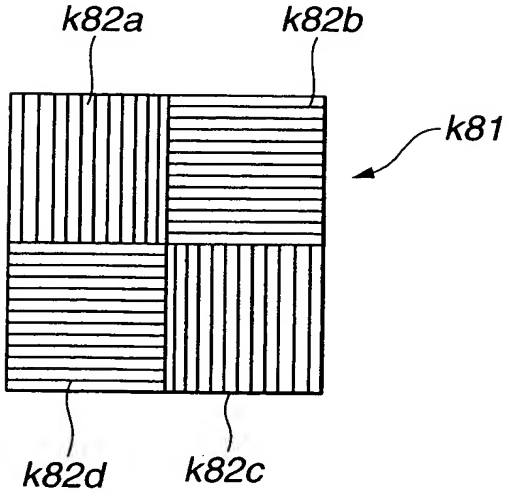

FIG.42

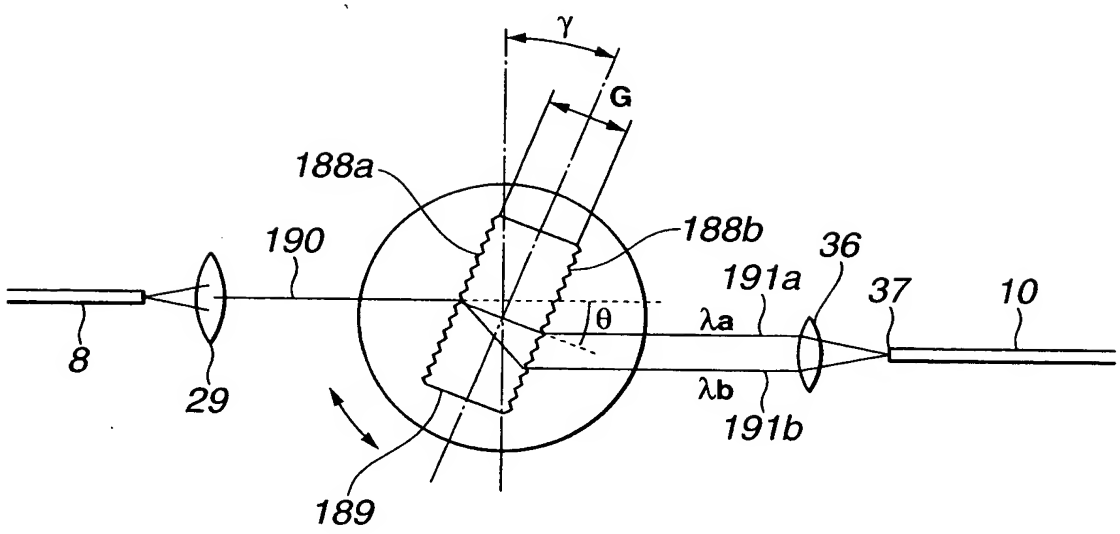
γ
G
188a
188b
190
36
191a
37
10
θ
λa
8
29
λb
191b
189

FIG.43

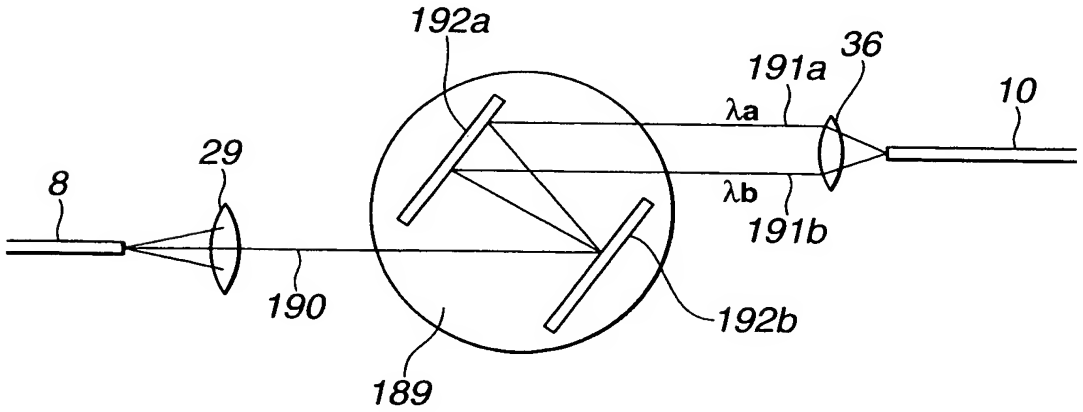
192a
36
191a
10
λa
29
8
λb
191b
190
192b
189

FIG.44

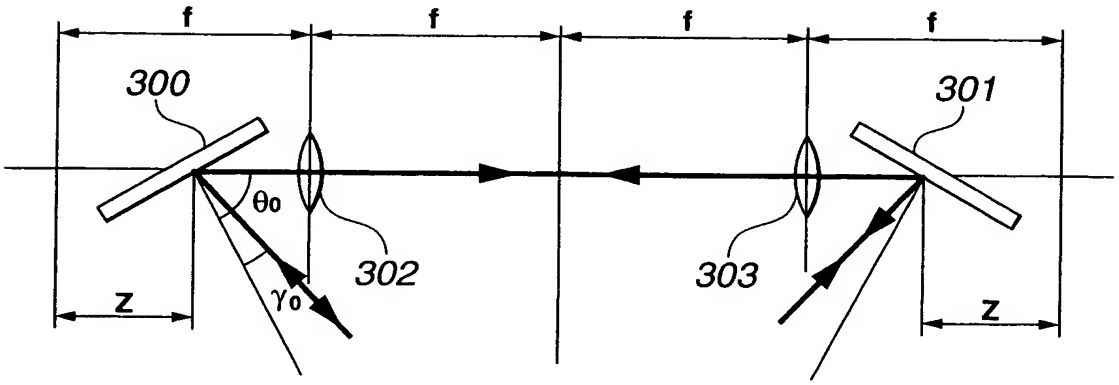
f
f
f
f
300
301
θo
302
303
γo
Z
Z

FIG.45

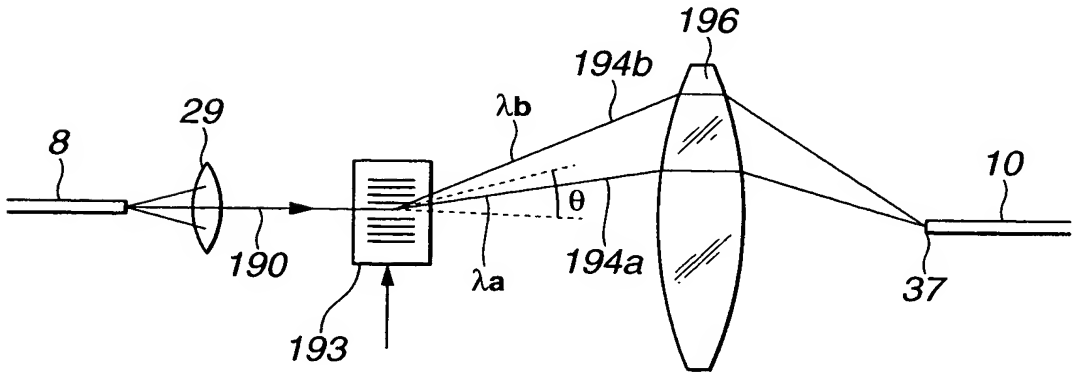
196
194b
λb
29
8
10
θ
190
λa
194a
37
193

FIG.46

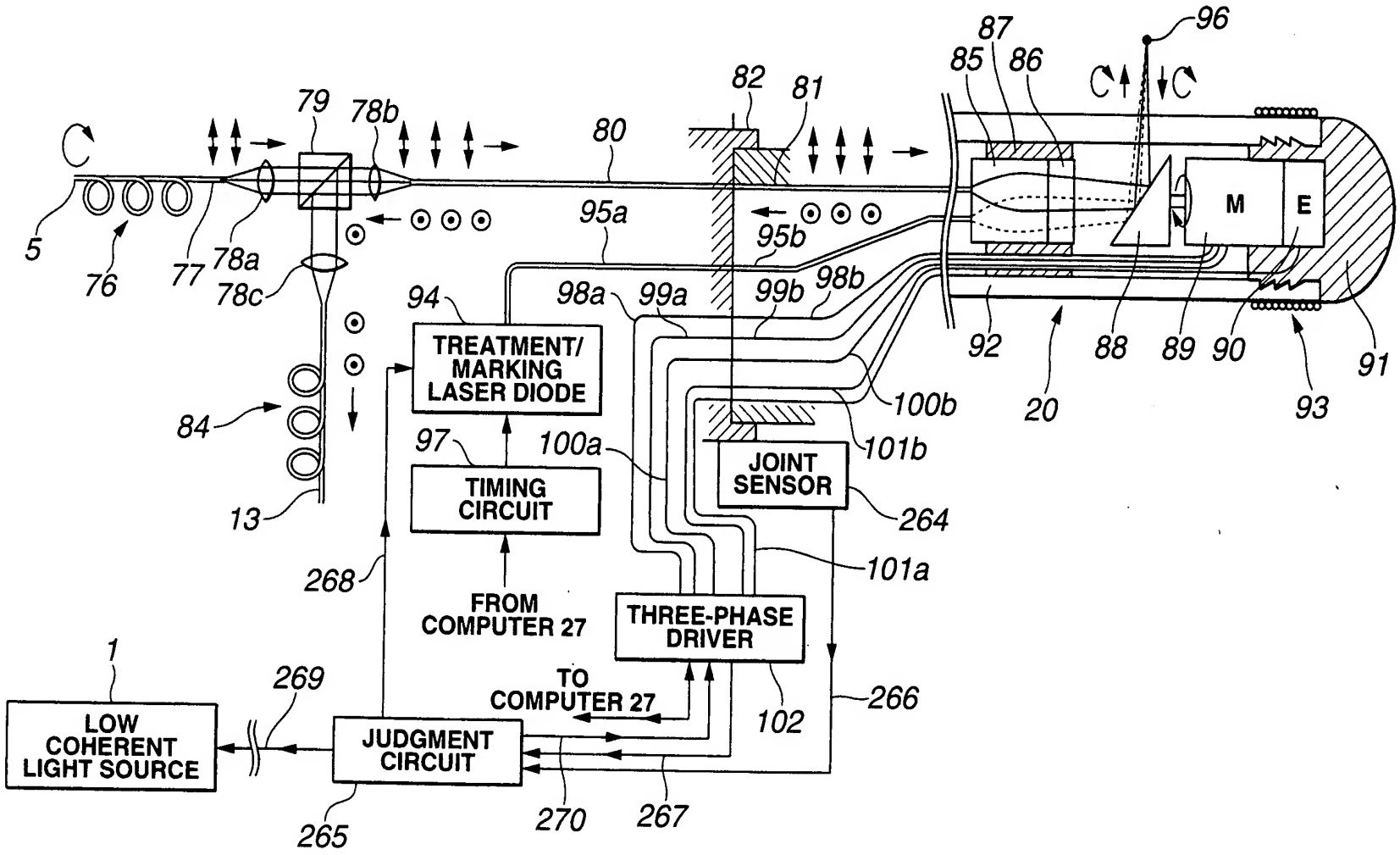
TREATMENT/ MARKING LASER DIODE
TIMING CIRCUIT
FROM COMPUTER 27
JOINT SENSOR
THREE-PHASE DRIVER
TO COMPUTER 27
LOW COHERENT LIGHT SOURCE
JUDGMENT CIRCUIT
M
E
1
5
76
77
78a
78b
78c
79
80
81
82
84
85
86
87
88
89
90
91
92
93
94
95a
95b
96
97
98a
98b
99a
99b
100a
100b
101a
101b
102
13
20
264
265
266
267
268
269
270

FIG.47

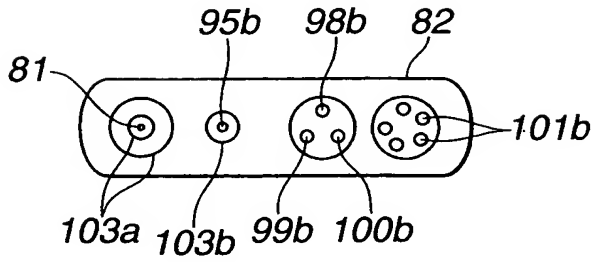

FIG.48

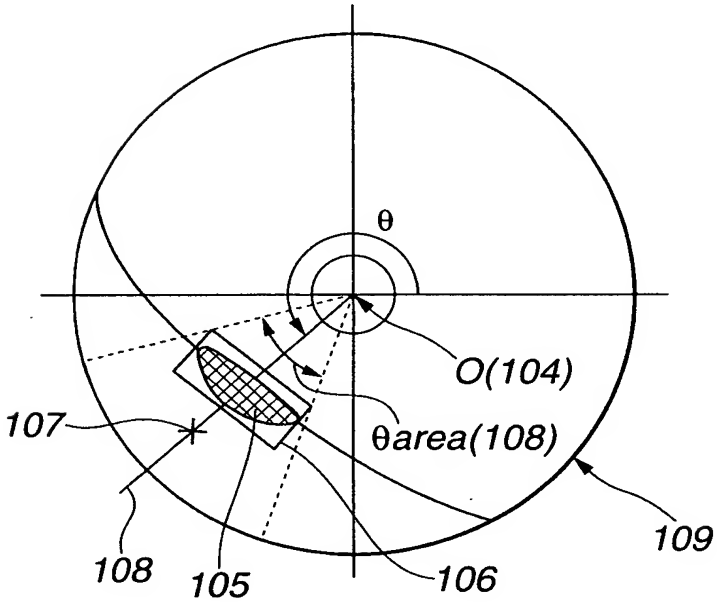

FIG.49

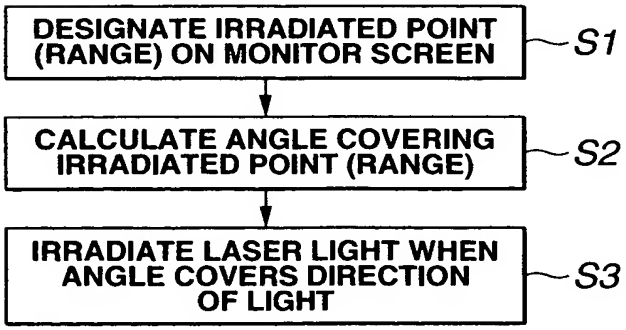

FIG.50

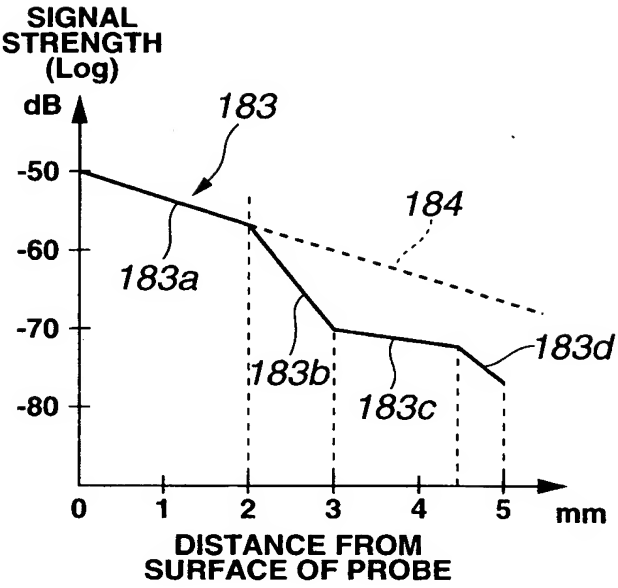
SIGNAL STRENGTH (Log)
dB
-50
-60
-70
-80
183
184
183a
183b
183c
183d
0
1
2
3
4
5
mm
DISTANCE FROM SURFACE OF PROBE

FIG.51

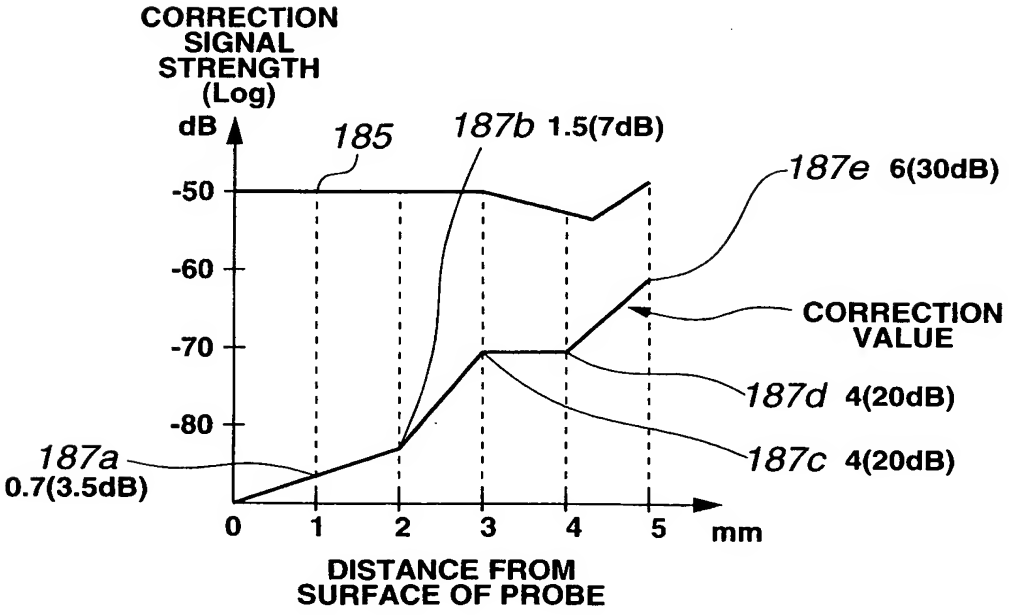
CORRECTION SIGNAL STRENGTH (Log)
dB
-50
-60
-70
-80
185
187b 1.5(7dB)
187e 6(30dB)
CORRECTION VALUE
187d 4(20dB)
187c 4(20dB)
187a 0.7(3.5dB)
0
1
2
3
4
5
mm
DISTANCE FROM SURFACE OF PROBE

FIG.52

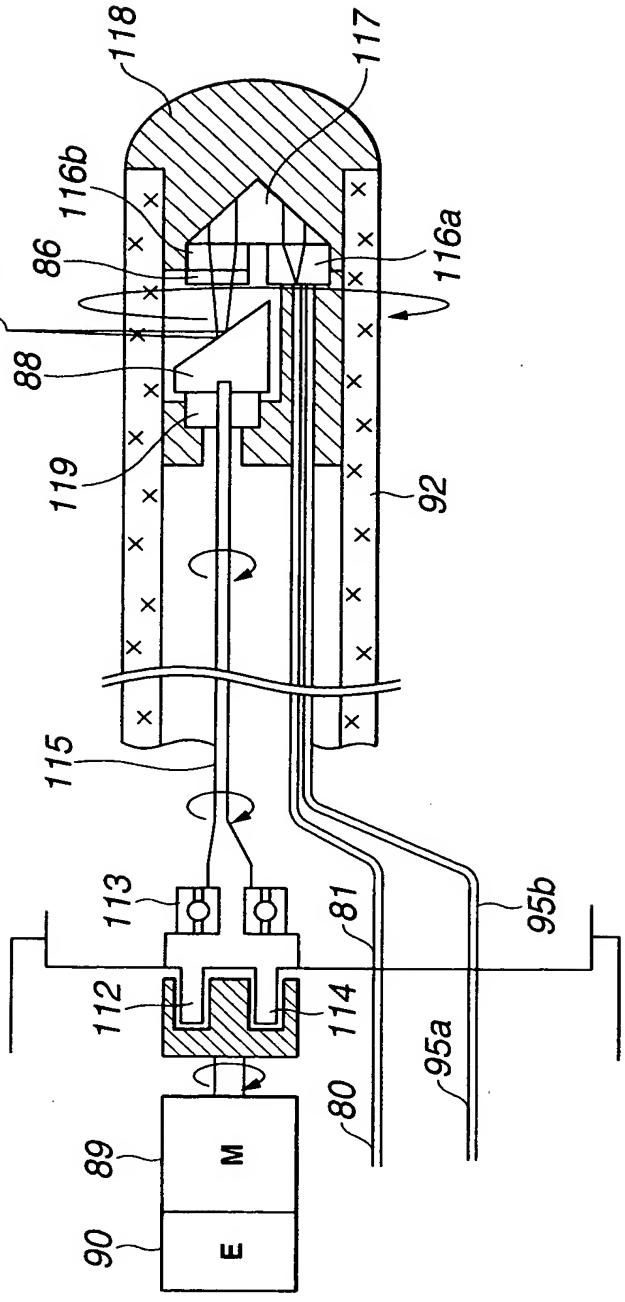
118
117
116b
116a
86
96
88
119
92
115
113
81
95b
112
114
95a
80
89
M
90
E

FIG.53

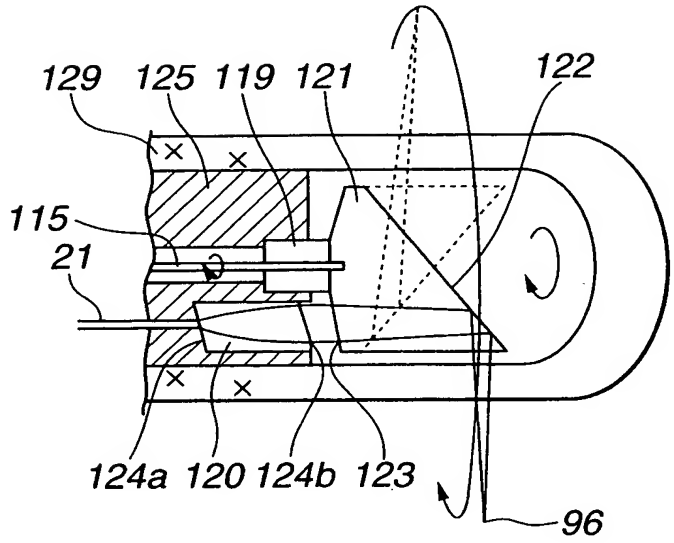

FIG.54

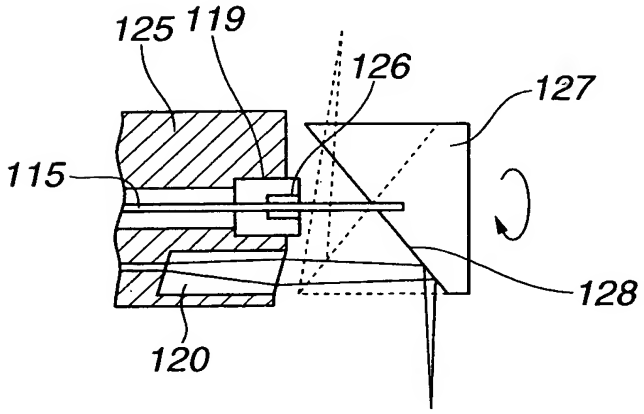

FIG.55

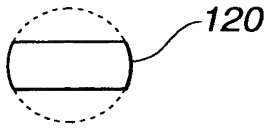

FIG.56

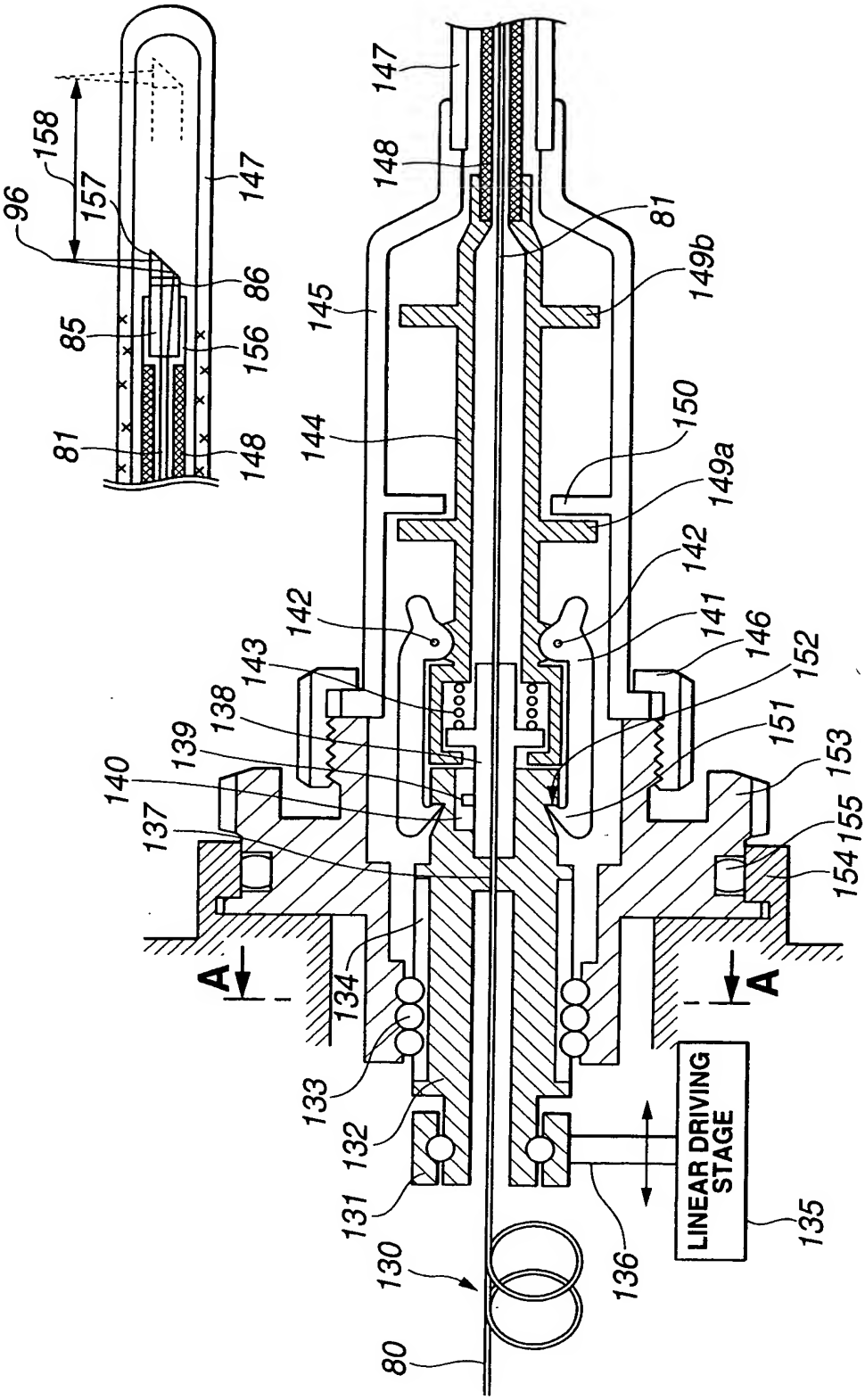
96
158
157
147
86
85
156
81
148
144
145
148
147
81
149b
150
149a
142
141
146
152
151
153
155
154
143
138
139
140
137
134
133
132
131
130
80
136
135
LINEAR DRIVING STAGE
A
A

FIG.57

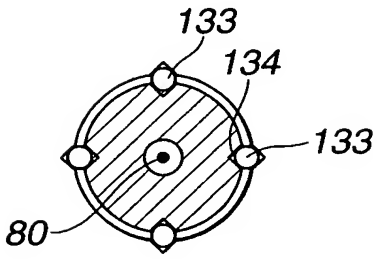

FIG.58

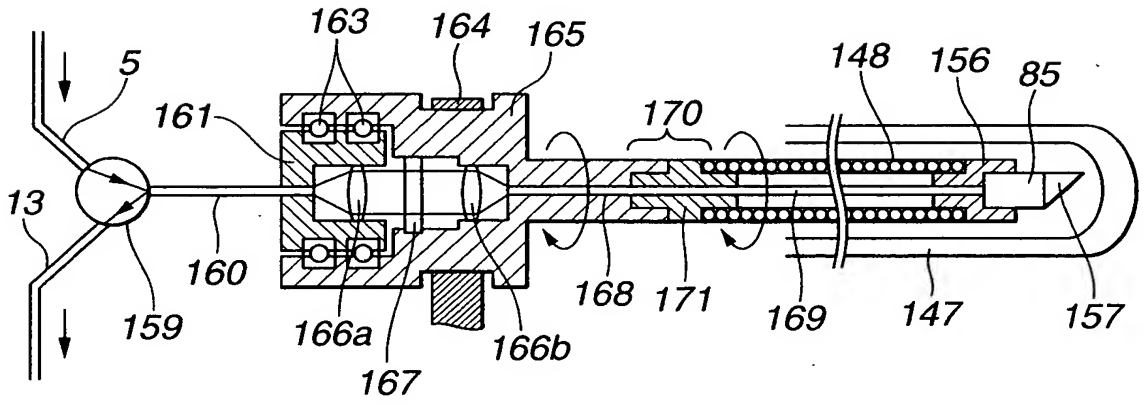

FIG.59

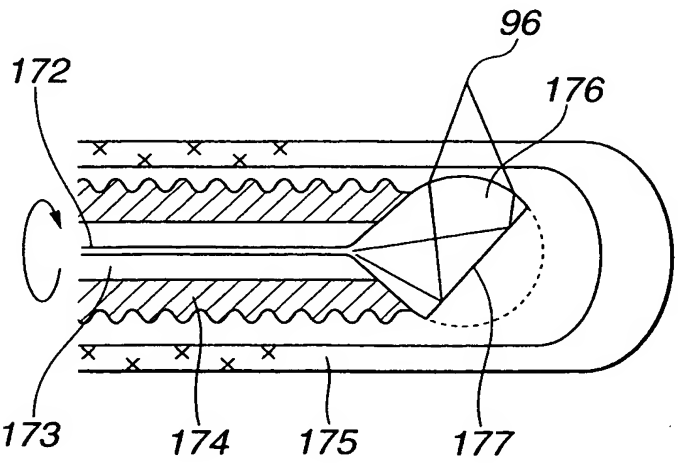

FIG.60

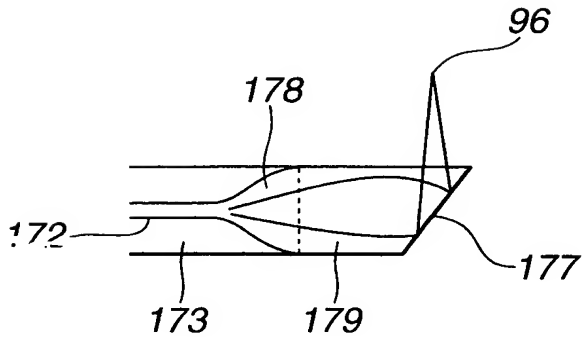

FIG.61

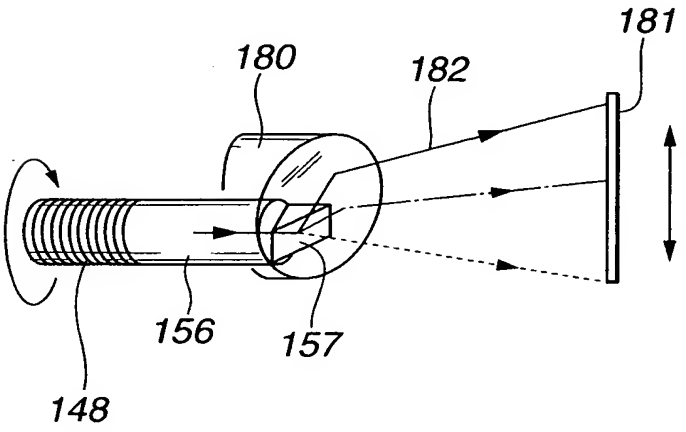

FIG.62

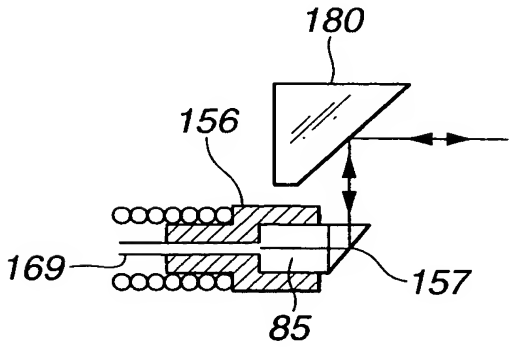

FIG.63

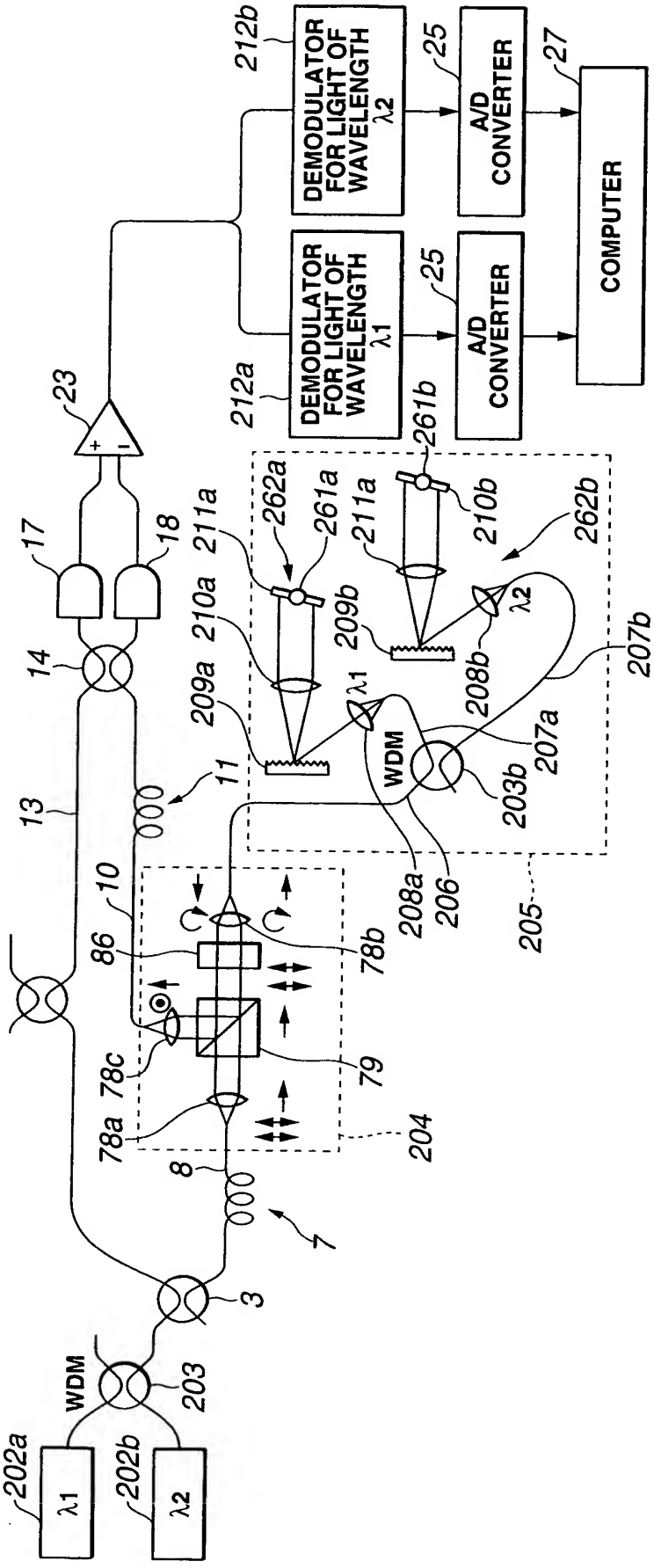
202a
λ1
202b
λ2
WDM
203
3
8
7
78a
78c
79
78b
86
10
204
13
11
14
17
18
23
+
-
211a
210a
209a
262a
261a
λ1
WDM
209b
211a
210b
262b
λ2
208b
207b
207a
203b
208a
206
205
261b
212a
212b
DEMODULATOR FOR LIGHT OF WAVELENGTH λ1
DEMODULATOR FOR LIGHT OF WAVELENGTH λ2
25
A/D CONVERTER
A/D CONVERTER
27
COMPUTER

FIG.64

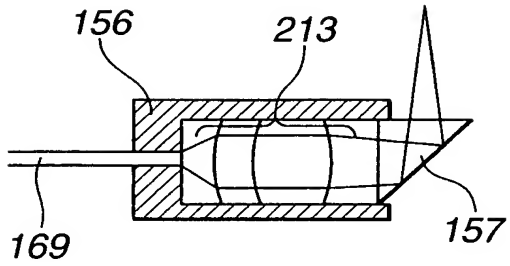

FIG.65

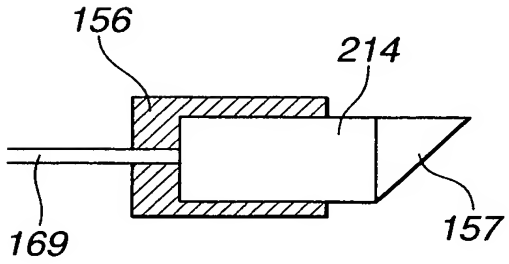

FIG.66

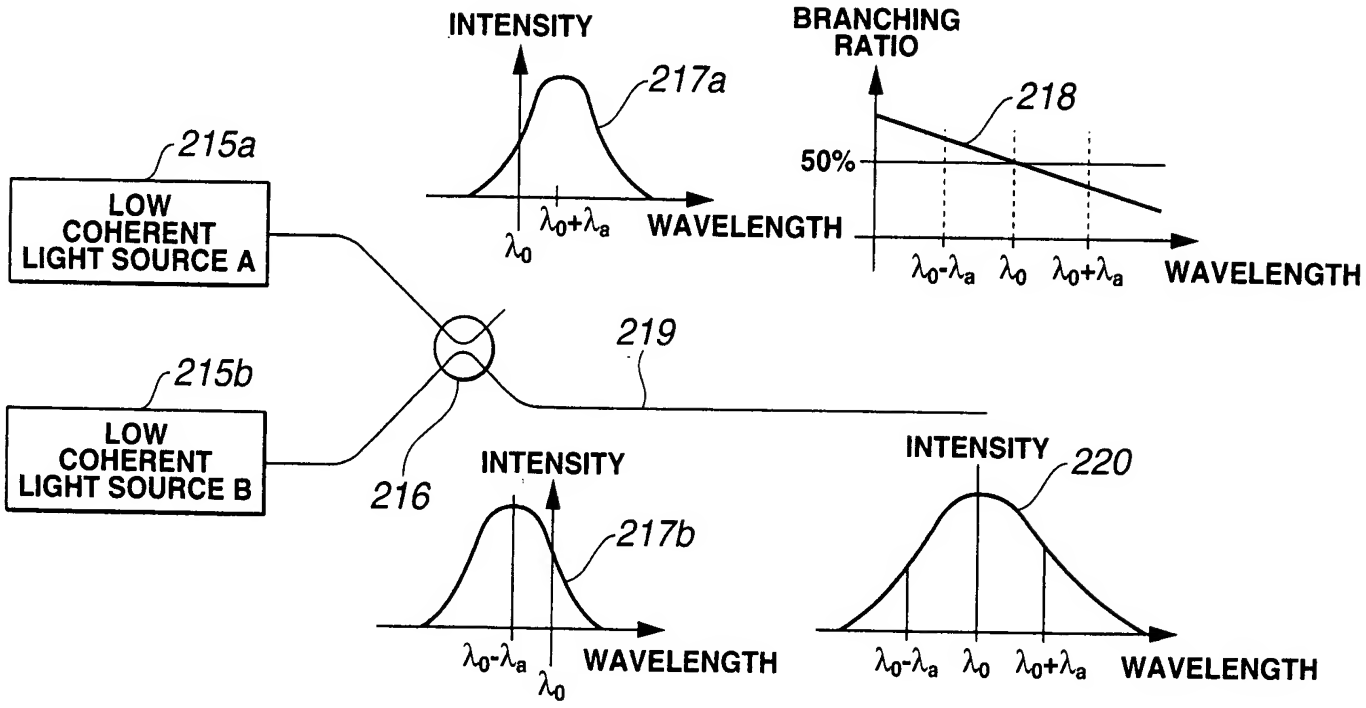
INTENSITY
217a
λ_0
$\lambda_0+\lambda_a$
WAVELENGTH
BRANCHING RATIO
218
50%
$\lambda_0-\lambda_a$
λ_0
$\lambda_0+\lambda_a$
WAVELENGTH
215a
LOW COHERENT LIGHT SOURCE A
215b
LOW COHERENT LIGHT SOURCE B
216
219
INTENSITY
217b
$\lambda_0-\lambda_a$
λ_0
WAVELENGTH
INTENSITY
220
$\lambda_0-\lambda_a$
λ_0
$\lambda_0+\lambda_a$
WAVELENGTH

FIG.67

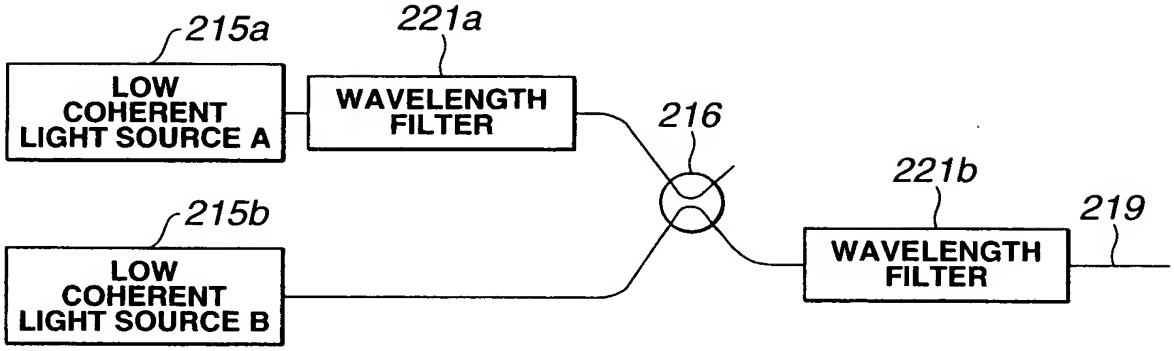
215a
221a
LOW COHERENT LIGHT SOURCE A
WAVELENGTH FILTER
216
221b
219
215b
LOW COHERENT LIGHT SOURCE B
WAVELENGTH FILTER

FIG.68

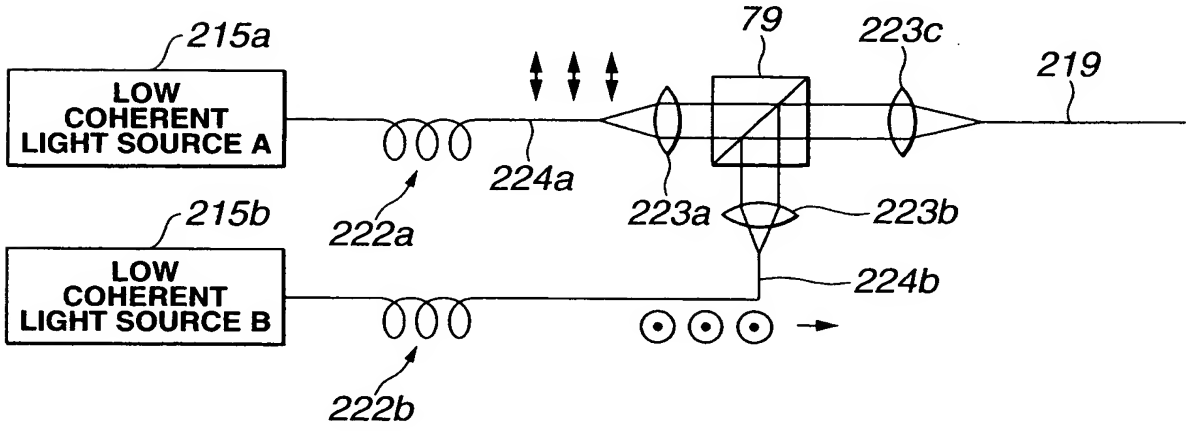
215a
79
223c
219
LOW COHERENT LIGHT SOURCE A
224a
223a
223b
215b
222a
LOW COHERENT LIGHT SOURCE B
224b
222b

FIG.69

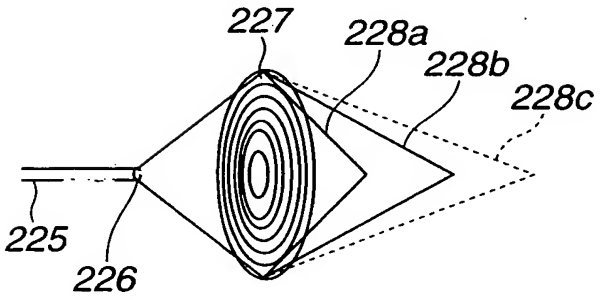

FIG.70

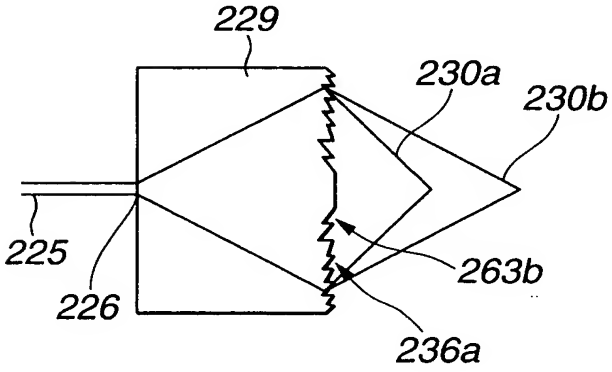

FIG.71

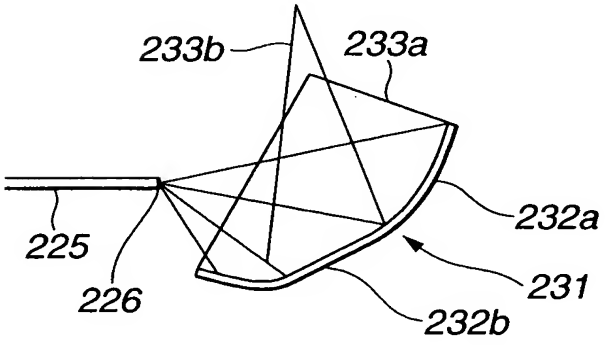

FIG.72

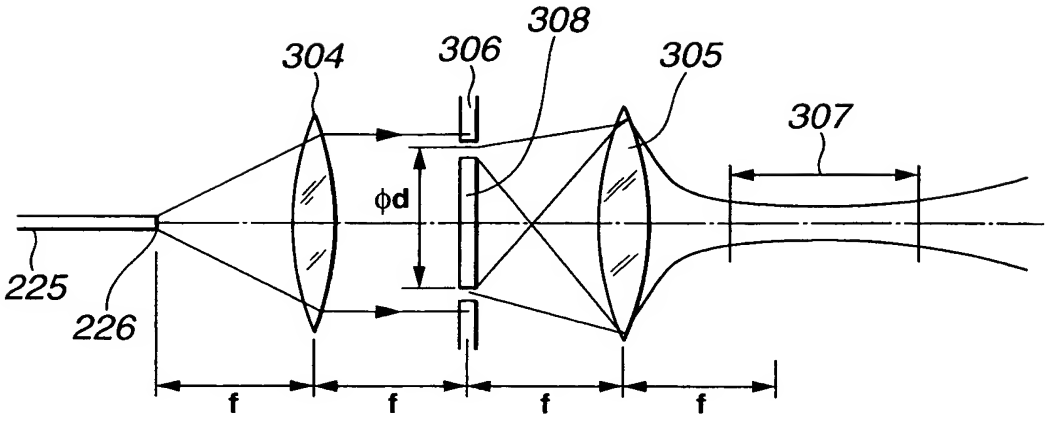

FIG.73

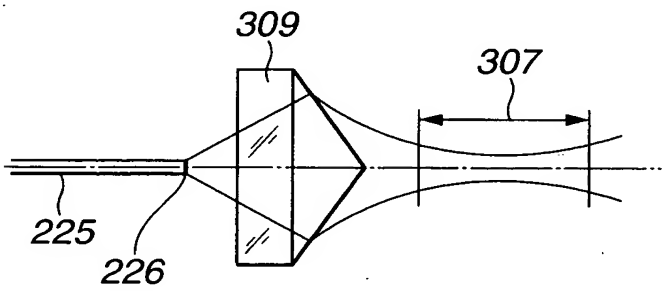

FIG.74

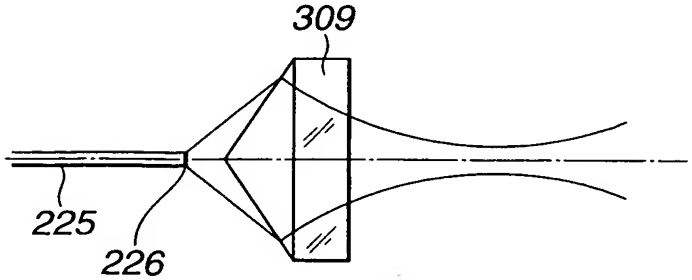

FIG.75

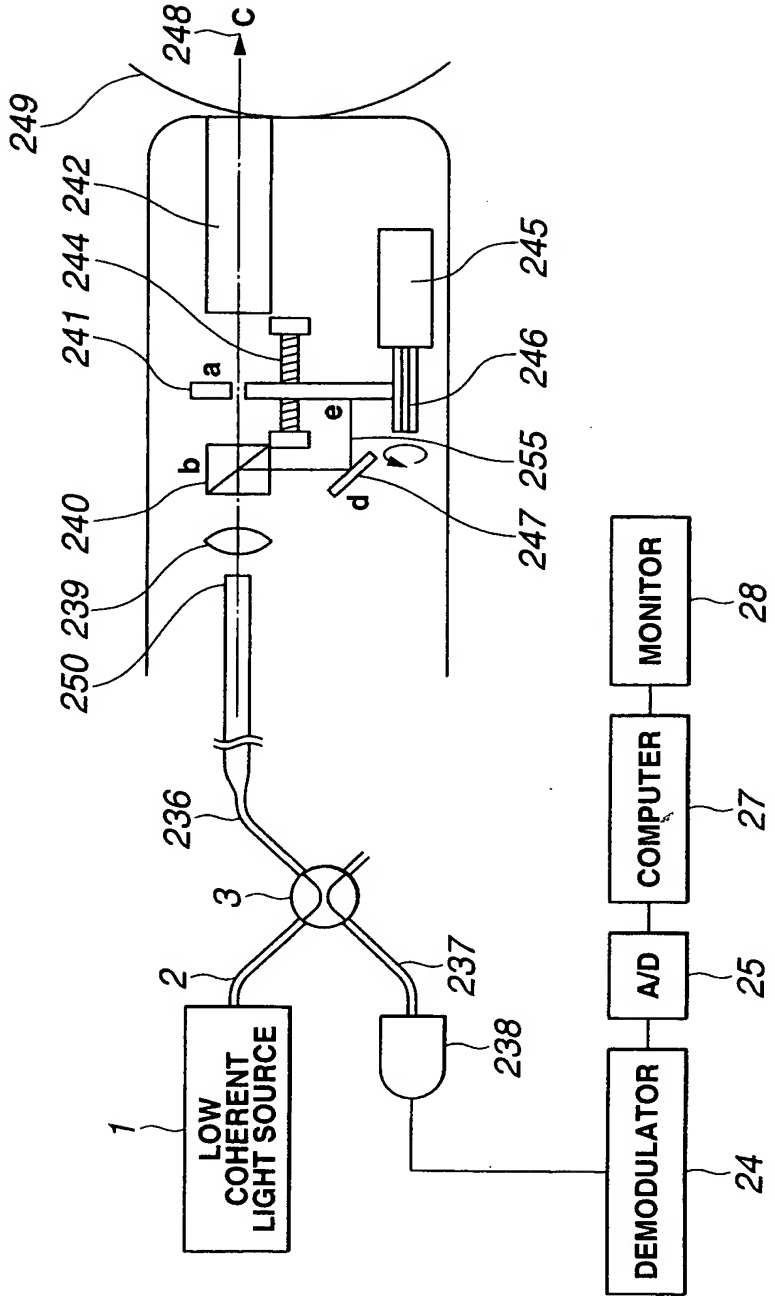
LOW COHERENT LIGHT SOURCE
1
2
3
236
237
238
240
239
250
249
248
C
242
241
244
245
246
255
247
a
b
d
e
DEMODULATOR
24
A/D
25
COMPUTER
27
MONITOR
28

FIG.76

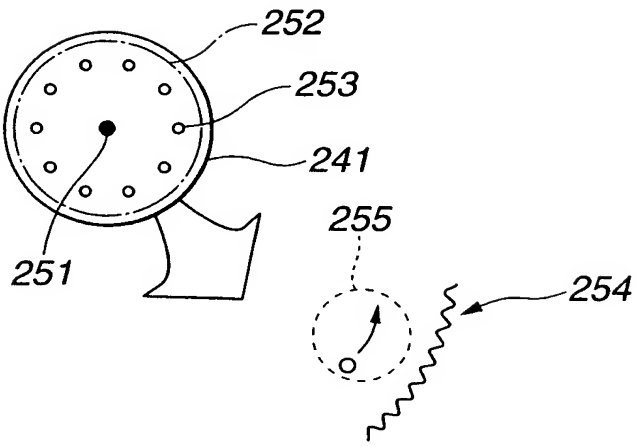
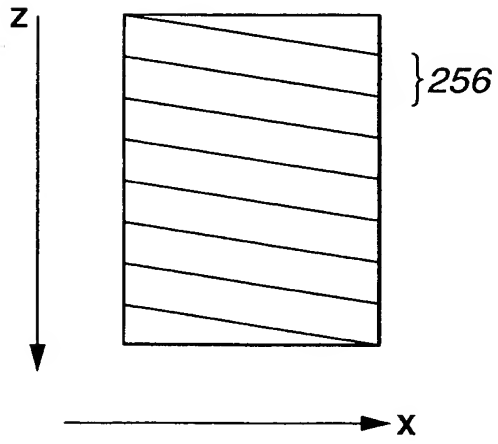
FIG.77